BMJ Open

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Journal:	*BMJ Open*
Manuscript ID	bmjopen-2016-014133
Article Type:	Protocol
Date Submitted by the Author:	02-Sep-2016
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Primary Subject Heading:	Medical education and training
Secondary Subject Heading:	Rehabilitation medicine
Keywords:	chronic fatigue syndrome, cognitive behaviour therapy, graded exercise therapy, education, online, randomised controlled trial

A randomised controlled trial of online continuing education for health professionals to improve the management of chronic fatigue syndrome. A study protocol.

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Word count: 2131

Key words: chronic fatigue syndrome, cognitive behaviour therapy, graded exercise therapy, education, online, randomised controlled trial

ABSTRACT

Introduction

Chronic fatigue syndrome (CFS) is a serious and debilitating illness that affects between 0.2-2.6% of the world's population. Although there is Level One evidence of the benefit of cognitive behavior therapy (CBT) and graded exercise therapy (GET) for people with CFS, uptake of these interventions is low or at best untimely. This can be attributed to poor clinician awareness and knowledge of CFS and the CBT and GET interventions aimed at managing its symptoms. The aim of this trial is to evaluate the effect of participation in an online education program, compared with a wait-list control group, on allied health professionals' knowledge about evidence-based CFS interventions and their levels of confidence to engage in the dissemination of these interventions.

Methods and analysis

A randomised controlled trial consisting of 180 consenting allied health practitioners will be conducted. Participants will be randomised into an intervention group (n=90) that will receive access to the online education program, or a wait-list control group (n=90). The primary outcome will be knowledge and clinical reasoning skills regarding CFS and its management, assessed via short answer and multiple choice questions (MCQ), measured at baseline, post-intervention (week 4) and follow-up. Secondary outcomes include: 1) self-reported confidence in knowledge and clinical reasoning skills related to CFS, and 2) self-reported success in treating people with CFS. Satisfaction with the online education program and the influence of the education program on clinical practice behaviour will also be assessed.

Ethics and dissemination

The study protocol has been approved by the Human Research Ethics Committee at The University of New South Wales (approval number HC16419). Results will be disseminated via peer reviewed journal articles, and presentations at scientific conferences and meetings.

Trial registration number

Trial protocol was registered with the Australian and New Zealand Clinical Trials Registry (ACTRN12616000296437p) on 7 March 2016.

Strengths:

- Randomised controlled trial
- Objective and subjective assessment measures
- Translation of evidence-based interventions to practice
- Engaging multiple allied health professions

Limitations:

- Follow-up measurements made on a cohort rather than intervention and control groups
- Actual impact on practice is assessed only by clinician report and in the short term
- Trial recruitment is confined to Australia
- Customised assessments for this study have not previously been validated

INTRODUCTION

Chronic fatigue syndrome (CFS) is a serious and debilitating illness that affects between 0.2-2.6% of the world's population[1]. Cochrane reviews of both cognitive behaviour therapy (CBT)[2] and graded exercise therapy (GET)[3] provide Level One evidence of their benefits for people with CFS. More than 20 randomised controlled trials by independent researchers examining the effectiveness of CBT or GET across separate patient groups and in various geographical locations have found beneficial effects of these interventions for CFS, and did not identify harmful effects of these interventions (for a review see[4]). There is also recent evidence that combining CBT and GET may be more effective than CBT alone[5]. These interventions have also proved effective in routine clinical practice[6]. In the absence of a clear understanding of the underlying pathophysiology of CFS, or curative treatments, evidence-based interventions aimed at managing symptoms and improving function should be readily available[7]. Yet uptake of evidence-based CFS management programs is low[8 9]. Recent studies have shown that gaps between research and practice are largely due to health professionals lacking the knowledge and skills to provide appropriate care[10 11].

For several reasons it is crucial that allied health professionals have the capacity to provide evidence-based CBT and GET interventions to patients with CFS. First, it should be a patient's right that interventions proven to assist in the management of their symptoms are readily available. Second, it is widely acknowledged that over-exertion can lead to exacerbation of fatigue symptoms (for examples see[12 13]), thus inappropriate prescription of physical and cognitive activities will result in poor treatment outcome. Many patients and practitioners incorrectly assume GET involves the development of a traditional exercise program that requires marked physical exertion which should be continued regardless of increasing symptoms (this is an easy mistake to make given the misleading term: *graded*

exercise therapy). However, after appropriate day-to-day pacing of regular activities, GET merely commences with conservative incremental increases in the duration of physical activities that are executed daily, including incidental tasks such as domestic chores. This is followed by gradual progression to more structured exercise, such as walking, which is introduced very cautiously and at levels far below physical activity guidelines for the general population. Thus, to provide safe and effective GET for people with CFS some clinicians may need to recalibrate their notions of exercise.

Finally, and very importantly, many health professionals have outdated views on the aetiology of CFS, which can result in the use of inappropriate treatments and hence patient frustration. Rooted in historically dismissive views from some clinicians is a concern of some people with CFS that the advocacy of a psychological intervention, such as CBT, implies that their illness is "all in their head" and not a real disease. Education of clinicians about CFS and the role of CBT is an important step to help address such misunderstandings.

Improving health practitioner knowledge via online continuing education activities has been widely documented[14 15]. Yet there has been very little research into interventions that aim to influence health practitioner knowledge and practice in relation to CFS. One study investigated whether community health care centres were able to implement and sustain a CBT intervention for people with CFS by using an implementation manual[16]. They found that while patients showed an improvement in fatigue severity and physical function, practitioners required considerable external support from the authors of the study for successful implementation of the manual. An alternative method to improve practitioner knowledge and practice is through online education programs. The impact of online educational interventions has been investigated in some areas of health care (e.g.,[17 18]), but

none, to our knowledge, have investigated the impact on online educational activities regarding CFS management. The aim of this trial is to evaluate the effect of participation in an online education program, compared with a wait-list control group, on allied health practitioners' knowledge about evidence-based CFS interventions and their levels of confidence to deliver these interventions.

METHODS AND ANALYSIS:

Trial design

A randomised controlled trial will be conducted in accordance with the CONsolidated Standards of Reporting Trials (CONSORT) statement[19] as shown in Figure 1. The trial is reported according to the Recommendations for Interventional Trials (SPIRIT) statement[20] and the education intervention is described according to the Template for Intervention Description and Replication (TIDieR) checklist[21].

Eligibility criteria

Australian allied health practitioners (e.g., Psychologists, Exercise Physiologists, Physiotherapists, Occupational Therapists) will be randomly allocated to either the education group (immediate access to the online education program) or to a wait-list control group. People will be eligible for inclusion in the trial if they are a fully registered, allied health practitioner. Individuals who are not currently practicing will be excluded.

Recruitment

One hundred and eighty allied health practitioners will be recruited via advertisements published in continuing professional development (CPD) calendars or newsletters of professional organisations, or distributed to existing mailing lists of appropriate organisations (e.g., Exercise and Sports Science Australia, Australian Physiotherapy Association,

Australian Psychology Society, Australian Clinical Psychology Association, Occupational Therapy Australia). Participant recruitment will start in September 2016.

Sample size calculation

A total sample of 128 participants is required to detect a moderate effect size ($d = 0.5$) of improvement in clinician knowledge of CFS management and confidence to implement evidence-based CFS interventions, with a power of 80% and a 2-tailed alpha of 0.05. To account for a potential attrition rate of 30% we intend to recruit 180 participants. These estimates of attrition rate and effect size are based on a similar previous study investigating online education for health practitioners[17].

Randomisation

Participants will be randomly allocated to the education or wait-list control group after consenting to participate. Randomisation will be conducted by an investigator not involved in recruitment or analysis of data to ensure concealment of allocation. A computer-generated random number sequence with randomly permuted block sizes of 2 – 6 will be used to ensure a balance between groups whilst different allied health professions are successively enrolled.

Intervention

The online education program is an interactive, self-paced online activity that has been developed from a CFS Treatment Manual previously created, and tested for efficacy, by the research group[22]. The content contains an introduction and seven modules that include information on CFS symptoms, assessment and diagnosis and detailed descriptions of interventions used to manage CFS symptoms, as well as material on conditions that may occur secondary to fatigue (e.g. reduced mood, anxiety, etc.). The remaining modules cover: psychoeducation, activity pacing and GET, interventions for sleep disturbance, interventions for cognitive disturbance (e.g., cognitive remediation), and interventions for mood, anxiety

and emotion coping. Intervention adherence will be tracked automatically by using the online platform to provide data on total time spent on the whole intervention, as well as time spent on each module, and on integrated assessment tasks and other facets of the online education program.

Table 1. Intervention description using the Template for Intervention Description and Replication (TIDieR) checklist.

Brief name	**Online education program for allied health practitioners on CFS and evidence-based CFS interventions**
Why	The intervention has been designed based on a manual developed by the research group that drew on Cochrane reviews of CBT and GET interventions for CFS. Additionally, reviews of internet-based education programs (e.g., [14]) indicate online education interventions are as effective as traditional training methods and have the advantage of being easily accessible.
What materials	The online education program is presented as a mix of text, audiovisual resources (including training videos) and interactive activities using the Smart Sparrow platform: https://www.smartsparrow.com.
What procedures	A number of modules are presented in the online education program as outlined below: Introduction ▪ Defines chronic fatigue states ▪ Fatigue assessment tools Module 1: Psychoeducation ▪ Rationale underlying the treatment approach Module 2: Activity pacing and graded exercise therapy ▪ Activity pacing ▪ Gradual progression of physical activities (GET) Module 3: Interventions for sleep-wake cycle disturbance ▪ Symptoms of sleep-wake cycle disturbance ▪ Sleep hygiene and CBT interventions for sleep-wake cycle disturbance Module 4: Interventions for neurocognitive disturbance ▪ Pacing of cognitive activities ▪ Gradual progression of cognitive activities (CET) Module 5: Interventions for mood disturbance ▪ How to distinguish between depression and chronic fatigue states ▪ Psychoeducation for mood disturbance ▪ CBT intervention for mood disturbance Module 6: Interventions for anxiety ▪ Anxiety symptoms ▪ CBT interventions for anxiety Module 7: Interventions for coping ▪ Effective coping strategies

Who provided	The online education program was designed and developed by five clinical psychologists, one research psychologist, five exercise physiologists and a medical specialist, all with significant clinical experience in treating people with chronic fatigue states.
How	The online education program is delivered individually as a self-paced online activity.
Where	Participants may access the online education program wherever they have a device with online access.
When and how much	The link to sign up to the study will be made available for 4-months. The intervention is self-paced. The activity will collect data on how long participants spend on each module and assessment activity.
Tailoring	All participants will receive the same content.

Wait-list control group

The wait-list control group will be given access to the online education program immediately after completing the post-intervention assessment measures, which will be 4 to 5 weeks after completion of the baseline assessment measures.

Outcomes

All outcomes will be determined by participants completing an online questionnaire and assessment at three time points. Both groups will complete the outcome measures at baseline (week 0) and post-intervention (week 4-5), while the follow-up measures will be completed in week 12 for the education group and week 16 for the wait-list control group.

RCT study

The primary outcome measures will be:

1. Participants' knowledge about CFS and CFS interventions measured at post intervention compared with baseline. Multiple choice and short answer questions, integrated with case vignettes, will test participants' knowledge about CFS symptoms, differential diagnosis, CFS management strategies and interventions (CBT and GET), and

interventions for conditions that commonly arise secondary to fatigue (reduced mood and anxiety).

2. Participants' self-reported confidence in their knowledge of CFS and confidence in their clinical skills to implement evidence-based CFS interventions. This part of the questionnaire requires participants to rate their confidence in their knowledge and clinical skills related to CFS using a 5-point Likert scale anchored at one end with "not at all confident" and at the other end with "very confident".

Secondary outcome measures

Data on adherence to and satisfaction with the education activity will be collected for the education group only. Intervention adherence will be tracked using in-built features of the online education platform, which will monitor: time spent in total on the activity, time spent on each module of the activity and engagement in integrated formative assessment tasks. In the post-intervention assessment, participants will be asked to rate their agreement with a number of statements related to their satisfaction with the online education activity. This will be done using a 5-point Likert scale anchored at one end with "strongly disagree" and at the other end with "strongly agree". Open-ended responses will also be collected.

Cohort study outcomes

Primary outcome measures

1. Participants' self-reported success in treating people with CFS or medically-unexplained fatigue. This part of the questionnaire requires participants to rate their level of success in treating people with CFS or medically unexplained fatigue using a 5-point Likert scale, anchored at one end with "completely unsuccessful" and at the other end with "completely successful".

2. Participants self-reported portion of clinical practice devoted to people with CFS or medically unexplained fatigue. This part of the questionnaire requires the participant to indicate the percentage of their clinical practice that is devoted to people with CFS or medically unexplained fatigue.

Secondary outcome measures

The secondary outcome measure will be the retention of knowledge about CFS and CFS interventions, and confidence of participants' in their clinical skills, across the follow up period subsequent to the post-intervention assessment.

Analysis of outcomes

Between group differences at baseline (i.e., education group versus wait-list control group) will be determined using independent t-tests for the knowledge assessment (primary outcome measure) and Mann-Whitney U tests for the Likert scale ratings (secondary outcome measures). To determine if the group receiving the online education program improve in knowledge and confidence related to the management of CFS, compared to the wait-list control group, an intention-to-treat analysis will be used. Group differences in change scores from baseline to post-intervention will be analysed with independent t-tests for the knowledge assessment, and with Mann-Whitney U tests for the measure of clinician confidence. Short answer responses in the assessments will be graded in duplicate by blinded markers, using standardised answer criteria. Open-ended responses regarding participant satisfaction with the online education will be coded and analysed thematically using NVivo software. Descriptive statistics will be generated from Likert scale responses to the questionnaire items regarding satisfaction with the intervention. All statistical analyses will be conducted on de-identified data using SPSS software.

For the cohort study, retention of knowledge will be assessed using a dependent t-test comparing post-intervention and follow-up assessment scores for the education group. An intention-to-treat analysis will not be used in this instance so that retention of learning is not artificially inflated. To provide a preliminary indication of the impact of the intervention on clinical practice we will compare the change in measures of practice behaviour from baseline to follow-up in cohort study with the outcome measures for both groups combined. This pragmatic approach should ensure a sufficient sample at follow up.

DISCUSSION

Given the serious and debilitating nature of CFS, the limited understanding of the pathophysiological mechanisms that underlie it and the absence of curative treatments, it is unfortunate that there has been limited uptake of evidence-based treatments aimed at managing symptoms and improving patient function. To our knowledge there have been no studies to date that have investigated the impact of an online education program on clinician knowledge and skills related to CFS management by allied health professionals. This trial aims to evaluate if an online education program improves clinicians' knowledge and confidence to treat patients with CFS.

Reflective of the multidisciplinary nature of CBT/GET interventions, the education intervention is being trialled across a range of allied health professions who will have different background experience with regard to the two major aspects of the intervention. Learning analytics within the intervention, and performance on specific sets of questions within the trial assessments, will identify the extent to which learner background has influenced performance. Coupled with feedback from the trial participants regarding their satisfaction and learning preferences, it is possible on the elearning platform used in this trial

to refine activities by incorporating adaptive features particular to groups or individuals to tailor content and feedback.

The cohort study component of the trial will generate preliminary evidence to determine if the intervention has an impact on clinical practice behaviours, which would also be amendable to future further investigation using an optimised learning intervention. The readily distributable online education intervention has the potential to improve the capacity of a range of allied health professionals to provide effective interventions for people with CFS.

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ETHICS AND DISSEMINATION

The study protocol has been approved by the Human Research Ethics Committee at UNSW, Australia (approval number HC16419). The results of this trial will be disseminated via peer reviewed journal articles, and presentations at scientific conferences and meetings.

AUTHORS CONTRIBUTIONS

BB, AL, CS and SL conceived the study. SL, BB, CS, SC and AL initiated the study design and JC and TB assisted with implementation. SL, BB, CS, SC and AL are grant holders. SL and BB are conducting the primary statistical analysis. All authors contributed to the refinement of the study protocol and approved the final manuscript. We would also like to acknowledge Gary Goldie's technical assistance with the Smart Sparrow platform.

FUNDING STATEMENT

This work is supported by JJ Mason & HS Williams Memorial Foundation (Grant number: RG152214)

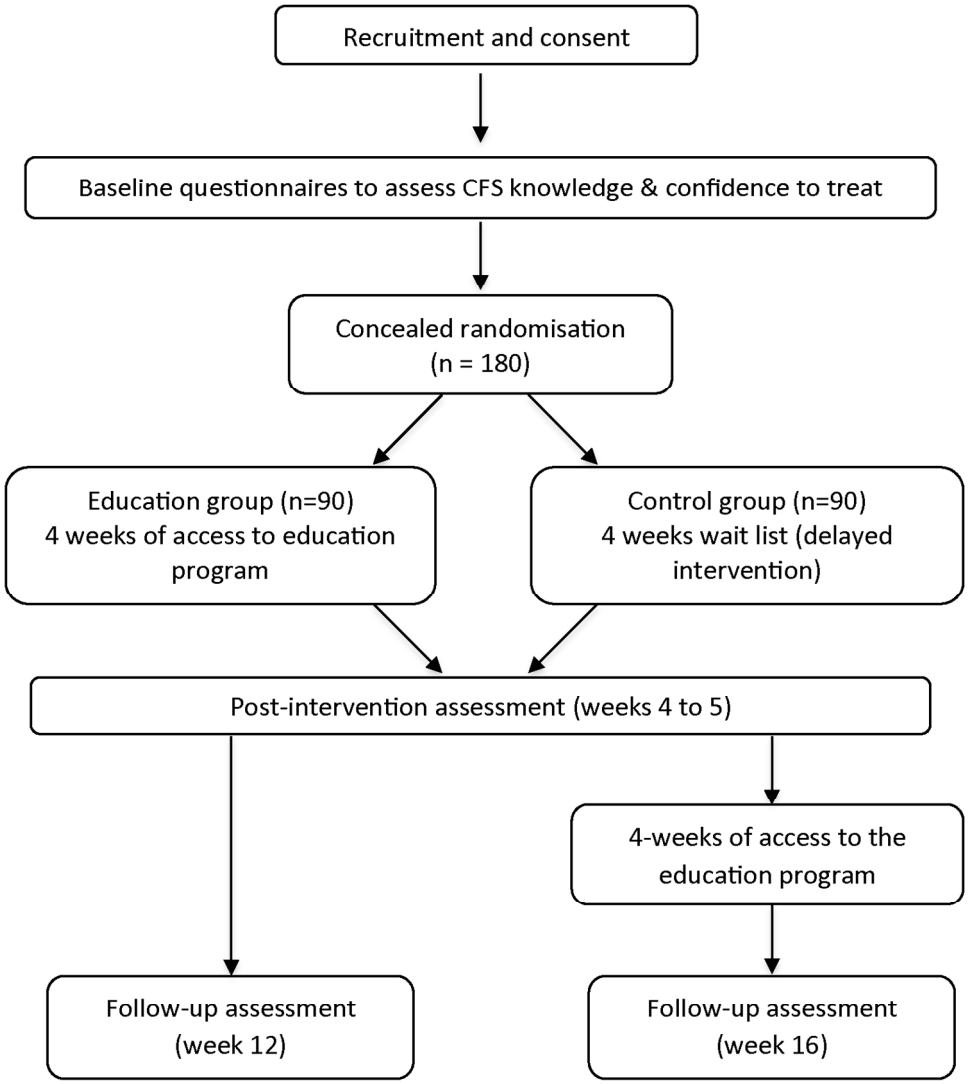
COMPETING INTERESTS

None of the authors having competing interests to declare.

LEGENDS

Figure 1. Trial design.

Table 1. Intervention description using the Template for Intervention Description and Replication (TIDieR) checklist.



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Manuscript ID	bmjopen-2016-014133.R1
Article Type:	Protocol
Date Submitted by the Author:	17-Dec-2016
Complete List of Authors:	Li, Sophie; University of New South Wales, School of Medical Sciences; University of New South Wales, School of Psychology Sandler, Carolina; University of New South Wales, School of Medical Sciences Casson, Sally; University of New South Wales, School of Medical Sciences Cassar, Joanne; University of New South Wales, School of Medical Sciences Bogg, Tina; University of New South Wales, School of Medical Sciences Lloyd, Andrew; University of New South Wales, The Kirby Institute Barry, Benjamin; University of New South Wales, School of Medical Sciences; The University of New South Wales, Neuroscience Research Australia
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ABSTRACT

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- Trial recruitment is confined to Australia
- Customised assessments for this study have not previously been validated

INTRODUCTION

Chronic fatigue syndrome (CFS) refers to the presence of persistent and severe fatigue that is accompanied by musculo-skeletal pain, neurocognitive difficulties, in addition to sleep and mood disturbances, and cannot be accounted for by a medical condition [1]. It is a serious and debilitating illness that affects between 0.2-2.6% of the world's population[2]. Cochrane reviews of both cognitive behaviour therapy (CBT)[3] and graded exercise therapy (GET)[4] provide Level One evidence of their benefits for people with CFS. More than 20 randomised controlled trials by independent researchers examining the effectiveness of CBT or GET across separate patient groups and in various geographical locations have found beneficial effects of these interventions for CFS in group-wise outcome analyses (for a review see[5]). There is also recent evidence that combining CBT and GET may be more effective than CBT alone[6]. When applied appropriately the interventions are not associated with harm [4, 7, 8], although the beneficial effects vary in magnitude from modest to clinically significant [3, 4]. These interventions have also proved generally effective in routine clinical practice[9]. In the absence of a clear understanding of the underlying pathophysiology of CFS, or curative treatments, as these are the only evidence-based interventions aimed at managing symptoms and improving function, they should be readily available[10]. Yet uptake of evidence-based CFS management programs delivered by allied health professionals such as psychologists, exercise physiologists and physiotherapists is low[11, 12]. Recent studies have shown that gaps between research and practice are at least partially due to allied health professionals lacking the knowledge and skills to provide appropriate care[13, 14], and potentially also the effects of the controversy regarding the PACE trial analysis[15].

For several reasons it is crucial that allied health professionals have the capacity to provide evidence-based CBT and GET interventions to patients with CFS. First, it should be a

patient's right that interventions proven to assist in the management of their symptoms are readily available. Second, it is widely acknowledged that over-exertion can lead to exacerbation of fatigue symptoms (for examples see[16, 17]), thus inappropriate prescription of physical and cognitive activities will result in poor treatment outcome. Many patients and allied health professionals incorrectly assume GET involves the development of a traditional exercise program (this is an easy mistake to make given the potentially misleading term: *graded exercise therapy*) that requires marked physical exertion, which should be continued regardless of increasing symptoms. However, after appropriate day-to-day pacing of regular activities has been established - that is, establishing a daily or weekly schedule of activities that does not exceed the individual's energy thresholds [[7] - GET merely commences with conservative incremental increases in the duration of daily physical activities, including incidental tasks such as domestic chores. This is followed by gradual progression to more structured exercise, such as walking, which is introduced and cautiously increased in a graded fashion, generally at levels far below physical activity guidelines for the general population [7]. Thus, to provide safe and effective GET for people with CFS some clinicians may need to recalibrate their notions of exercise. The implementation of GET as part of an intervention for people with CFS subsequent to the establishment of appropriate pacing of activities is important because activity pacing alone does not consistently provide benefit [7, 18].

Finally, and very importantly, many health professionals have outdated views on the aetiology of CFS, which can result in the use of inappropriate treatments and hence patient frustration. Rooted in historically dismissive views from some clinicians is a concern of some people with CFS that the advocacy of a psychological intervention, such as CBT, implies that their illness is "all in their head" and not a real disease. Education of clinicians about CFS and the role of CBT is an important step to help address such misunderstandings.

Improving allied health professional knowledge via online continuing education activities has been widely documented[19 20]. Yet there has been very little research into interventions that aim to influence allied health professional knowledge and practice in relation to CFS. One study investigated whether community health care centres were able to implement and sustain a CBT intervention for people with CFS by using an implementation manual[21]. They found that while patients showed an improvement in fatigue severity and physical function, health professionals required considerable external support from the authors of the study for successful implementation of the manual. Online education programs are an alternative method to improve health professional knowledge and practice, as has been demonstrated in other areas of health care (for example, [22, 23]). While the impact of online educational interventions has been investigated in some areas of health care (e.g.,[22-24]), none, to our knowledge, have investigated the impact on online educational activities regarding CFS management. The aim of this trial is to evaluate the effect of participation in an online education program on allied health professionals' knowledge about evidence-based CFS interventions and their levels of confidence to deliver these interventions, compared with a wait-list control group. Retention of knowledge, satisfaction with the online education program and the influence of the education program on clinical practice behaviour will also be assessed, in a cohort study design with participants pooled from the intervention and wait-list control groups

METHODS AND ANALYSIS:

Trial design

A randomised controlled trial will be conducted in accordance with the Consolidated Standards of Reporting Trials (CONSORT) statement[25] as shown in Figure 1. The trial design was developed and is reported according to the Recommendations for Interventional Trials (SPIRIT) statement[26] and the education intervention is described according to the Template for Intervention Description and Replication (TIDieR) checklist[27]. In addition to the RCT, a cohort study will be conducted that will assess changes in self-reported success in treating people with CFS and practice behaviours from baseline to follow-up for both groups combined.

Eligibility criteria

Australian allied health professionals (e.g., Psychologists, Exercise Physiologists, Physiotherapists, Occupational Therapists) will be randomly allocated to either the education group (immediate access to the online education program) or to a wait-list control group. People will be eligible for inclusion in the trial if they are a fully registered, allied health professional. Individuals who are not currently practicing will be excluded.

Recruitment

One hundred and eighty allied health professionals will be recruited via advertisements published in continuing professional development (CPD) calendars or newsletters of professional organisations, or distributed to existing mailing lists of appropriate organisations (e.g., Exercise and Sports Science Australia, Australian Physiotherapy Association, Australian Psychology Society, Australian Clinical Psychology Association, Occupational Therapy Australia). The recruitment notices and advertisements will contain a hyperlink that when accessed will provide information about the study and allow the individual to provide consent if wishing to participate. Those consenting to participate will then be contacted by an experimenter with further instructions regarding the trial. Upon entering the study, the

participant is allocated a participant identification code. To protect the participants' privacy, the outcome data is kept in a separate password protected file from the document containing the participants' names and identification codes. All documents related to the study are stored on a restricted access server in password-protected files as per UNSW HREC requirements.

Participant recruitment will start in September 2016.

Sample size calculation

A total sample of 128 participants is required to detect a moderate effect size ($d = 0.5$) of improvement in clinician knowledge of CFS management and confidence to implement evidence-based CFS interventions, with a power of 80% and a 2-tailed alpha of 0.05. To account for a potential attrition rate of 30% we intend to recruit 180 participants. These estimates of attrition rate and effect size are based on a similar previous study investigating online education for health professionals[22].

Randomisation

Participants will be randomly allocated to the education or wait-list control group after consenting to participate. Randomisation will be conducted by an investigator not involved in recruitment or analysis of data to ensure concealment of allocation. A computer-generated random number sequence with randomly permuted block sizes of 2 – 6 will be used to ensure a balance between groups whilst different allied health professions are successively enrolled.

Intervention

The online education program is an interactive, self-paced online activity that has been developed from a CFS Treatment Manual previously created, and tested for efficacy, by the research group[7]. The content contains an introduction and seven modules that include information on CFS symptoms, assessment and diagnosis and detailed descriptions of

interventions used to manage CFS symptoms, as well as material on conditions that may occur secondary to fatigue (e.g. reduced mood, anxiety, etc.). The remaining modules cover: psychoeducation, activity pacing and GET, interventions for sleep disturbance, interventions for cognitive disturbance (e.g., cognitive remediation), and interventions for mood, anxiety and emotion coping. Intervention adherence will be tracked automatically by using the online platform to provide data on total time spent on the whole intervention, as well as time spent on each module, and on integrated assessment tasks and other facets of the online education program. To reduce contamination each participant has an individual password to access the online education program, and must be enrolled into the program by the experimenter (and are subsequently un-enrolled once they have received 4-weeks access to the program). Furthermore, feedback regarding correct responses to the outcome measures (i.e., the MCQs and case vignettes) is not provided.

Table 1. Intervention description using the Template for Intervention Description and Replication (TIDieR) checklist.

Brief name	**Online education program for allied health professionals on CFS and evidence-based CFS interventions**
Why	The intervention has been designed based on a manual developed by the research group that drew on Cochrane reviews of CBT and GET interventions for CFS. Additionally, a large review of internet-based education programs indicates online education interventions are as effective as traditional training methods and have the advantage of being easily accessible[19].
What materials	The online education program is presented as a mix of text, audiovisual resources (including training videos) and interactive activities using the Smart Sparrow platform: https://www.smartsparrow.com.
What procedures	A number of modules are presented in the online education program as outlined below: Introduction ▪ Defines chronic fatigue states (e.g., post cancer fatigue) ▪ Fatigue assessment tools Module 1: Psychoeducation ▪ Rationale underlying the treatment approach Module 2: Activity pacing and graded exercise therapy ▪ Activity pacing

	▪ Gradual progression of physical activities (GET) Module 3: Interventions for sleep-wake cycle disturbance ▪ Symptoms of sleep-wake cycle disturbance ▪ Sleep hygiene and CBT interventions for sleep-wake cycle disturbance Module 4: Interventions for neurocognitive disturbance ▪ Pacing of cognitive activities ▪ Gradual progression of cognitive activities (CET) Module 5: Interventions for mood disturbance ▪ How to distinguish between depression and chronic fatigue states ▪ Psychoeducation for mood disturbance ▪ CBT intervention for mood disturbance Module 6: Interventions for anxiety ▪ Anxiety symptoms ▪ CBT interventions for anxiety Module 7: Interventions for coping ▪ Effective coping strategies
Who provided	The online education program was designed and developed by five clinical psychologists, one research psychologist, five exercise physiologists and a medical specialist, all with significant clinical experience in treating people with chronic fatigue states.
How	The online education program is delivered individually as a self-paced online activity.
Where	Participants may access the online education program wherever they have a device with online access.
When and how much	Each participant will have access to the online education program for a duration of four weeks. The intervention is self-paced. The activity will collect data on how long participants spend on each module and assessment activity.
Tailoring	All participants will receive the same content.

Control group

The wait-list control group will be given access to the online education program immediately after completing the post-intervention assessment measures, which will be 4 to 5 weeks after completion of the baseline assessment measures.

Outcomes

All outcomes (with the exception of adherence to and satisfaction with the online education activity) will be determined by participants completing an online questionnaire and assessment at three time points. Both groups will complete the outcome measures at baseline (week 0) and post-intervention (week 4-5), while the follow-up measures will be completed

in week 12 for the education group and week 16 for the wait-list control group (i.e., 8 weeks after cessation of access to the online education for both groups). Adherence to and satisfaction with the online education program will be collected as Post-assessment for the Education group only. In addition, information regarding profession type of the individual and years of practice will be collected to determine profession and level of professional experience.

RCT study

The primary outcome measures will be:

1. Participants' knowledge about CFS and CFS interventions measured at post intervention compared with baseline. Multiple choice and short answer questions, integrated with case vignettes, will test participants' knowledge about CFS symptoms, differential diagnosis, CFS management strategies and interventions (CBT and GET), and interventions for conditions that commonly arise secondary to fatigue (reduced mood and anxiety).
2. Participants' self-reported confidence in their knowledge of CFS and confidence in their clinical skills to implement evidence-based CFS interventions. This part of the questionnaire requires participants to rate their confidence in their knowledge and clinical skills related to CFS using a 5-point Likert scale ("not at all confident", "not very confident", "somewhat confident", "confident" and "very confident").

These measures have been constructed by an expert research group consisting of physicians, exercise physiologists and clinical psychologists and designed to test knowledge across the range of allied health professions.

Secondary outcome measures

The secondary outcome measures will be:

1. The retention of knowledge about CFS and CFS interventions, and confidence of participants' in their clinical skills, across the follow up period subsequent to the post-intervention assessment. This data will be collected for the Education group only.
2. Adherence to, and satisfaction with, the education activity. This data will be collected for the Education group only. Intervention adherence will be tracked using in-built features of the online education platform, which will monitor: time spent in total on the activity, time spent on each module of the activity and engagement in integrated formative assessment tasks. In the post-intervention assessment, participants will be asked to rate their agreement with a number of statements related to their satisfaction with the online education activity. This will be done using a 5-point Likert scale anchored at one end with "strongly disagree" and at the other end with "strongly agree". Open-ended responses will also be collected.

Cohort study outcomes

Primary outcome measures are assessed at baseline and follow-up, and are:

1. Participants' self-reported success in treating people with CFS. This part of the questionnaire requires participants to rate their level of success in treating people with CFS using a 5-point Likert scale, anchored at one end with "completely unsuccessful" and at the other end with "completely successful".
2. Practice behaviours as evidenced by participants' self-reported proportion of clinical practice devoted to people with CFS. This part of the questionnaire requires the participant to indicate the percentage of their clinical practice that is devoted to management of people with CFS, for example the proportion of their clientele who have CFS, to determine levels of service provision.

Analysis of outcomes

Between group differences at baseline (i.e., education group versus wait-list control group) will be determined using independent t-tests for the knowledge assessment (primary outcome measure) and Mann-Whitney U tests for the Likert scale ratings (secondary outcome measures). To determine if the group receiving the online education program improve in knowledge and confidence related to the management of CFS, compared to the wait-list control group, an intention-to-treat analysis will be used. Group differences in change scores from baseline to post-intervention will be analysed with independent t-tests for the knowledge assessment, and with Mann-Whitney U tests for the measure of clinician confidence. Short answer responses in the assessments will be graded in duplicate by blinded markers, using standardised answer criteria. Open-ended responses regarding participant satisfaction with the online education will be coded and analysed thematically using NVivo software. Descriptive statistics will be generated from Likert scale responses to the questionnaire items regarding satisfaction with the intervention. Similarly, descriptive statistics will be generated for the total time spent on the online education program, time spent on each module, total time spent on the integrated formative assessment tasks, and responses on these tasks for each professional group. All statistical analyses will be conducted on de-identified data using SPSS software and the experimenter responsible for data analysis will be blinded to group allocation.

For the cohort study, retention of knowledge will be assessed using a dependent t-test comparing post-intervention and follow-up assessment scores for the education group only. An intention-to-treat analysis will not be used in this instance so that retention of learning is not artificially inflated. To provide a preliminary indication of the impact of the intervention on clinical practice we will compare the change in measures of practice behaviour (i.e., proportion of clinical practice devoted to the management of people with CFS) from baseline to follow-up in cohort study with the outcome measures for both groups combined. The range

in proportion of clinical practice devoted to people with CFS at baseline for both groups will also be described to account for potential biases in sampling. This pragmatic approach should ensure a sufficient sample at follow up.

DISCUSSION

Given the serious and debilitating nature of CFS and the absence of curative treatments, it is unfortunate that there has been limited uptake of evidence-based treatments aimed at managing symptoms and improving patient function. To our knowledge there have been no studies to date that have investigated the impact of an online education program on clinician knowledge and skills related to CFS management by allied health professionals. This trial aims to evaluate if an online education program improves clinicians' knowledge and confidence to treat patients with CFS.

Reflective of the multidisciplinary nature of CBT/GET interventions, the education intervention is being trialled across a range of allied health professions who will have different background experience with regard to the two major aspects of the intervention. Learning analytics within the intervention, and performance on specific sets of questions within the trial assessments, will identify the extent to which learner background has influenced performance. Coupled with feedback from the trial participants regarding their satisfaction and learning preferences, it is possible on the elearning platform used in this trial to refine activities by incorporating adaptive features particular to groups or individuals to tailor content and feedback.

The cohort study component of the trial will generate preliminary evidence to determine if the intervention has an impact on clinical practice behaviours, which would also be amenable to further investigation using an optimised learning intervention. Given the possibility of

convenience sampling of allied health professionals further investigation regarding the efficacy of the intervention on a sample that have yet to formulate opinions regarding intervention for CFS would also be valuable (e.g., implemented within a tertiary allied health training program or mandated for all staff within a health professional service). The readily distributable online education intervention has the potential to improve the capacity of a range of allied health professionals to provide effective interventions for people with CFS.

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ETHICS AND DISSEMINATION

The study protocol has been approved by the Human Research Ethics Committee at UNSW, Australia (approval number HC16419). The results of this trial will be disseminated via peer reviewed journal articles, and presentations at scientific conferences and meetings.

AUTHORS CONTRIBUTIONS

BB, AL, CS and SL conceived the study. SL, BB, CS, SC and AL initiated the study design and JC and TB assisted with implementation. SL, BB, CS, SC and AL are grant holders. SL and BB are conducting the primary statistical analysis. All authors contributed to the refinement of the study protocol and approved the final manuscript. We would also like to acknowledge Gary Goldie's technical assistance with the Smart Sparrow platform.

FUNDING STATEMENT

This work is supported by JJ Mason & HS Williams Memorial Foundation (Grant number: MAS2015F040)

COMPETING INTERESTS

None of the authors having competing interests to declare.

LEGENDS

Figure 1. Trial design.

Table 1. Intervention description using the Template for Intervention Description and Replication (TIDieR) checklist.

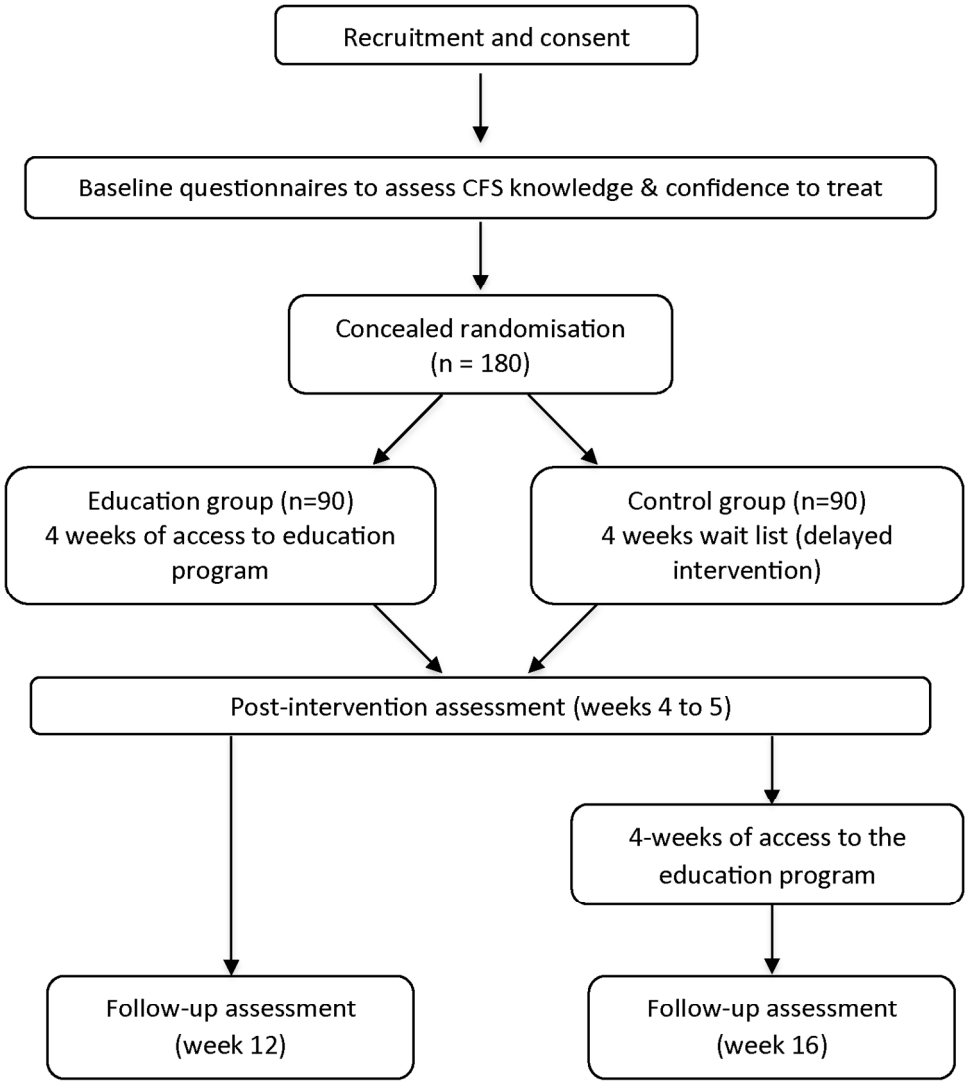

Figure 1. Trial design.

139x156mm (300 x 300 DPI)

SPIRIT
STANDARD PROTOCOL ITEMS: RECOMMENDATIONS FOR INTERVENTIONAL TRIALS

SPIRIT 2013 Checklist: Recommended items to address in a clinical trial protocol and related documents*

Section/item	Item No	Description	
Administrative information			
Title	1	Descriptive title identifying the study design, population, interventions, and, if applicable, trial acronym	P 1
Trial registration	2a	Trial identifier and registry name. If not yet registered, name of intended registry	P 3
	2b	All items from the World Health Organization Trial Registration Data Set	P 3
Protocol version	3	Date and version identifier	
Funding	4	Sources and types of financial, material, and other support	P 17
Roles and responsibilities	5a	Names, affiliations, and roles of protocol contributors	P1, P 17
	5b	Name and contact information for the trial sponsor	P 17
	5c	Role of study sponsor and funders, if any, in study design; collection, management, analysis, and interpretation of data; writing of the report; and the decision to submit the report for publication, including whether they will have ultimate authority over any of these activities	N/A
	5d	Composition, roles, and responsibilities of the coordinating centre, steering committee, endpoint adjudication committee, data management team, and other individuals or groups overseeing the trial, if applicable (see Item 21a for data monitoring committee)	P 17
Introduction			
Background and rationale	6a	Description of research question and justification for undertaking the trial, including summary of relevant studies (published and unpublished) examining benefits and harms for each intervention	P4-6
	6b	Explanation for choice of comparators	P 6
Objectives	7	Specific objectives or hypotheses	P 6
Trial design	8	Description of trial design including type of trial (eg, parallel group, crossover, factorial, single group), allocation ratio, and framework (eg, superiority, equivalence, noninferiority, exploratory)	P 7

Methods: Participants, interventions, and outcomes			
Study setting	9	Description of study settings (eg, community clinic, academic hospital) and list of countries where data will be collected. Reference to where list of study sites can be obtained	P10, table
Eligibility criteria	10	Inclusion and exclusion criteria for participants. If applicable, eligibility criteria for study centres and individuals who will perform the interventions (eg, surgeons, psychotherapists)	P 7
Interventions	11a	Interventions for each group with sufficient detail to allow replication, including how and when they will be administered	P8-10
	11b	Criteria for discontinuing or modifying allocated interventions for a given trial participant (eg, drug dose change in response to harms, participant request, or improving/worsening disease)	NA
	11c	Strategies to improve adherence to intervention protocols, and any procedures for monitoring adherence (eg, drug tablet return, laboratory tests)	P 11
	11d	Relevant concomitant care and interventions that are permitted or prohibited during the trial	NA
Outcomes	12	Primary, secondary, and other outcomes, including the specific measurement variable (eg, systolic blood pressure), analysis metric (eg, change from baseline, final value, time to event), method of aggregation (eg, median, proportion), and time point for each outcome. Explanation of the clinical relevance of chosen efficacy and harm outcomes is strongly recommended	P10-12
Participant timeline	13	Time schedule of enrolment, interventions (including any run-ins and washouts), assessments, and visits for participants. A schematic diagram is highly recommended (see Figure)	P 7, Figure1
Sample size	14	Estimated number of participants needed to achieve study objectives and how it was determined, including clinical and statistical assumptions supporting any sample size calculations	P 8
Recruitment	15	Strategies for achieving adequate participant enrolment to reach target sample size	P7-8
Methods: Assignment of interventions (for controlled trials)			
Allocation:			
Sequence generation	16a	Method of generating the allocation sequence (eg, computer-generated random numbers), and list of any factors for stratification. To reduce predictability of a random sequence, details of any planned restriction (eg, blocking) should be provided in a separate document that is unavailable to those who enrol participants or assign interventions	P 8

Allocation concealment mechanism	16b	Mechanism of implementing the allocation sequence (eg, central telephone; sequentially numbered, opaque, sealed envelopes), describing any steps to conceal the sequence until interventions are assigned	P 7
Implementation	16c	Who will generate the allocation sequence, who will enrol participants, and who will assign participants to interventions	P 8
Blinding (masking)	17a	Who will be blinded after assignment to interventions (eg, trial participants, care providers, outcome assessors, data analysts), and how	P 8
	17b	If blinded, circumstances under which unblinding is permissible, and procedure for revealing a participant's allocated intervention during the trial	NA
Methods: Data collection, management, and analysis			
Data collection methods	18a	Plans for assessment and collection of outcome, baseline, and other trial data, including any related processes to promote data quality (eg, duplicate measurements, training of assessors) and a description of study instruments (eg, questionnaires, laboratory tests) along with their reliability and validity, if known. Reference to where data collection forms can be found, if not in the protocol	P11-12
	18b	Plans to promote participant retention and complete follow-up, including list of any outcome data to be collected for participants who discontinue or deviate from intervention protocols	P 9
Data management	19	Plans for data entry, coding, security, and storage, including any related processes to promote data quality (eg, double data entry; range checks for data values). Reference to where details of data management procedures can be found, if not in the protocol	P 8
Statistical methods	20a	Statistical methods for analysing primary and secondary outcomes. Reference to where other details of the statistical analysis plan can be found, if not in the protocol	P 13
	20b	Methods for any additional analyses (eg, subgroup and adjusted analyses)	NA
	20c	Definition of analysis population relating to protocol non-adherence (eg, as randomised analysis), and any statistical methods to handle missing data (eg, multiple imputation)	P13-14
Methods: Monitoring			
Data monitoring	21a	Composition of data monitoring committee (DMC); summary of its role and reporting structure; statement of whether it is independent from the sponsor and competing interests; and reference to where further details about its charter can be found, if not in the protocol. Alternatively, an explanation of why a DMC is not needed	NA

	21b	Description of any interim analyses and stopping guidelines, including who will have access to these interim results and make the final decision to terminate the trial	NA
Harms	22	Plans for collecting, assessing, reporting, and managing solicited and spontaneously reported adverse events and other unintended effects of trial interventions or trial conduct	NA
Auditing	23	Frequency and procedures for auditing trial conduct, if any, and whether the process will be independent from investigators and the sponsor	NA
Ethics and dissemination			
Research ethics approval	24	Plans for seeking research ethics committee/institutional review board (REC/IRB) approval	P 3
Protocol amendments	25	Plans for communicating important protocol modifications (eg, changes to eligibility criteria, outcomes, analyses) to relevant parties (eg, investigators, REC/IRBs, trial participants, trial registries, journals, regulators)	
Consent or assent	26a	Who will obtain informed consent or assent from potential trial participants or authorised surrogates, and how (see Item 32)	P 7
	26b	Additional consent provisions for collection and use of participant data and biological specimens in ancillary studies, if applicable	NA
Confidentiality	27	How personal information about potential and enrolled participants will be collected, shared, and maintained in order to protect confidentiality before, during, and after the trial	P 8
Declaration of interests	28	Financial and other competing interests for principal investigators for the overall trial and each study site	P 18
Access to data	29	Statement of who will have access to the final trial dataset, and disclosure of contractual agreements that limit such access for investigators	
Ancillary and post-trial care	30	Provisions, if any, for ancillary and post-trial care, and for compensation to those who suffer harm from trial participation	NA
Dissemination policy	31a	Plans for investigators and sponsor to communicate trial results to participants, healthcare professionals, the public, and other relevant groups (eg, via publication, reporting in results databases, or other data sharing arrangements), including any publication restrictions	P 3
	31b	Authorship eligibility guidelines and any intended use of professional writers	NA
	31c	Plans, if any, for granting public access to the full protocol, participant-level dataset, and statistical code	NA

Appendices

Informed consent materials	32	Model consent form and other related documentation given to participants and authorised surrogates	NA online
Biological specimens	33	Plans for collection, laboratory evaluation, and storage of biological specimens for genetic or molecular analysis in the current trial and for future use in ancillary studies, if applicable	NA

*It is strongly recommended that this checklist be read in conjunction with the SPIRIT 2013 Explanation & Elaboration for important clarification on the items. Amendments to the protocol should be tracked and dated. The SPIRIT checklist is copyrighted by the SPIRIT Group under the Creative Commons "Attribution-NonCommercial-NoDerivs 3.0 Unported" license.

BMJ Open

A randomised controlled trial of online continuing education for health professionals to improve the management of chronic fatigue syndrome: A study protocol.

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2016-014133.R2
Article Type:	Protocol
Date Submitted by the Author:	19-Jan-2017
Complete List of Authors:	Li, Sophie; University of New South Wales, School of Medical Sciences; University of New South Wales, School of Psychology Sandler, Carolina; University of New South Wales, School of Medical Sciences Casson, Sally; University of New South Wales, School of Medical Sciences Cassar, Joanne; University of New South Wales, School of Medical Sciences Bogg, Tina; University of New South Wales, School of Medical Sciences Lloyd, Andrew; University of New South Wales, The Kirby Institute Barry, Benjamin; University of New South Wales, School of Medical Sciences; University of Queensland, School of Clinical Medicine
Primary Subject Heading:	Medical education and training
Secondary Subject Heading:	Rehabilitation medicine
Keywords:	chronic fatigue syndrome, cognitive behaviour therapy, graded exercise therapy, education, online, randomised controlled trial

A randomised controlled trial of online continuing education for health professionals to improve the management of chronic fatigue syndrome: A study protocol.

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Word count: 2893

Key words: chronic fatigue syndrome, cognitive behaviour therapy, graded exercise therapy, education, online, randomised controlled trial

ABSTRACT

Introduction

Chronic fatigue syndrome (CFS) is a serious and debilitating illness that affects between 0.2-2.6% of the world's population. Although there is Level One evidence of the benefit of cognitive behavior therapy (CBT) and graded exercise therapy (GET) for some people with CFS, uptake of these interventions is low or at best untimely. This can be partly attributed to poor clinician awareness and knowledge of CFS and related CBT and GET interventions. This trial aims to evaluate the effect of participation in an online education program, compared with a wait-list control group, on allied health professionals' knowledge about evidence-based CFS interventions and their levels of confidence to engage in the dissemination of these interventions.

Methods and analysis

A randomised controlled trial consisting of 180 consenting allied health professionals will be conducted. Participants will be randomised into an intervention group (n=90) that will receive access to the online education program, or a wait-list control group (n=90). The primary outcome will be knowledge and clinical reasoning skills regarding CFS and its management, measured at baseline, post-intervention and follow-up. Secondary outcomes include: 1) self-reported confidence in knowledge and clinical reasoning skills related to CFS, and 2) self-reported success in treating people with CFS. Retention of knowledge, satisfaction with the online education program and the influence of the education program on clinical practice behaviour will also be assessed in a cohort study design with participants from the intervention and control groups combined.

Ethics and dissemination

The study protocol has been approved by the Human Research Ethics Committee at The University of New South Wales (approval number HC16419). Results will be disseminated via peer reviewed journal articles, and presentations at scientific conferences and meetings.

Trial registration

Trial protocol was registered with the Australian and New Zealand Clinical Trials Registry (ACTRN12616000296437p) on 7 March 2016.

Strengths:

- Randomised controlled trial
- Objective and subjective assessment measures
- Translation of evidence-based interventions to practice
- Engaging multiple allied health professions

Limitations:

- Follow-up measurements made on a cohort rather than intervention and control groups
- Actual impact on practice is assessed only by clinician report and in the short term
- Trial recruitment is confined to Australia
- Customised assessments for this study have not previously been validated

INTRODUCTION

Chronic fatigue syndrome (CFS) refers to the presence of persistent and severe fatigue that is accompanied by musculo-skeletal pain, neurocognitive difficulties, in addition to sleep and mood disturbances, and cannot be accounted for by a medical condition[1]. It is a serious and debilitating illness that affects between 0.2-2.6% of the world's population[2]. Cochrane reviews of both cognitive behaviour therapy (CBT)[3] and graded exercise therapy (GET)[4] provide Level One evidence of their benefits for people with CFS. More than 20 randomised controlled trials by independent researchers examining the effectiveness of CBT or GET across separate patient groups and in various geographical locations have found moderately beneficial effects of these interventions for CFS, including significantly reduced levels of fatigue, functional impairment, depression and anxiety, in group-wise outcome analyses (for a review see[5]). There is also recent evidence that combining CBT and GET may be more effective than CBT alone[6]. When applied appropriately the interventions are not associated with harm[4, 7, 8], and the beneficial effects vary in magnitude from negligible to clinically significant[3, 4] (This conclusion relates to patients who are able to attend a clinic and may not generalise to more disabled patients). These interventions have also proved generally effective in routine clinical practice[9]. In the absence of a clear understanding of the underlying pathophysiology of CFS, or curative treatments, as these are the only evidence-based interventions aimed at managing symptoms and improving function, they should be readily available[10]. Yet uptake of evidence-based CFS management programs delivered by allied health professionals such as psychologists, exercise physiologists and physiotherapists is low[11, 12]. Recent studies have shown that gaps between research and practice are at least partially due to allied health professionals lacking the knowledge and skills to provide appropriate care[13, 14], and potentially also the effects of the controversy regarding the PACE trial analysis[15].

For several reasons it is crucial that allied health professionals have the capacity to provide evidence-based CBT and GET interventions to patients with CFS. First, it should be a patient's right that interventions proven to assist in the management of their symptoms are readily available. Second, it is widely acknowledged that over-exertion can lead to exacerbation of fatigue symptoms (for examples see[16, 17]), thus inappropriate prescription of physical and cognitive activities will result in poor treatment outcome. Many patients and allied health professionals incorrectly assume GET involves the development of a traditional exercise program (this is an easy mistake to make given the potentially misleading term: *graded exercise therapy*) that requires marked physical exertion, which should be continued regardless of increasing symptoms. However, after appropriate day-to-day pacing of regular activities has been established - that is, establishing a daily or weekly schedule of activities that does not exceed the individual's energy thresholds[7] - GET merely commences with conservative incremental increases in the duration of daily physical activities, including incidental tasks such as domestic chores. This is followed by gradual progression to more structured exercise, such as walking, which is introduced and cautiously increased in a graded fashion, generally at levels far below physical activity guidelines for the general population[7]. Thus, to provide safe and effective GET for people with CFS some clinicians may need to recalibrate their notions of exercise. The implementation of GET as part of an intervention for people with CFS subsequent to the establishment of appropriate pacing of activities is important because activity pacing alone does not consistently provide benefit[7, 18].

Finally, and very importantly, many health professionals have outdated views on the aetiology of CFS, which can result in the use of inappropriate treatments and hence patient

frustration. Rooted in historically dismissive views from some clinicians is a concern of some people with CFS that the advocacy of a psychological intervention, such as CBT, implies that their illness is "all in their head" and not a real disease. Education of clinicians about CFS and the role of CBT is an important step to help address such misunderstandings.

Improving allied health professional knowledge via online continuing education activities has been widely documented[19 20]. Yet there has been very little research into interventions that aim to influence allied health professional knowledge and practice in relation to CFS. One study investigated whether community health care centres were able to implement and sustain a CBT intervention for people with CFS by using an implementation manual[21]. They found that while patients showed an improvement in fatigue severity and physical function, health professionals required considerable external support from the authors of the study for successful implementation of the manual. Online education programs are an alternative method to improve health professional knowledge and practice, as has been demonstrated in other areas of health care (for example,[22, 23]). While the impact of online educational interventions has been investigated in some areas of health care (for example,[22-24]), none, to our knowledge, have investigated the impact of online educational activities on CFS management. The aim of this trial is to evaluate the effect of participation in an online education program on allied health professionals' knowledge about evidence-based CFS interventions and their levels of confidence to deliver these interventions, compared with a wait-list control group. Satisfaction with the online education program will also be assessed, as will retention of knowledge, for the intervention group only. The influence of the education program on clinical practice behavior will be assessed in a cohort study design with participants pooled from the intervention and wait-list control groups.

METHODS AND ANALYSIS:

Trial design

A randomised controlled trial will be conducted in accordance with the Consolidated Standards of Reporting Trials (CONSORT) statement[25] as shown in Figure 1. The trial design was developed and is reported according to the Recommendations for Interventional Trials (SPIRIT) statement[26] and the education intervention is described according to the Template for Intervention Description and Replication (TIDieR) checklist[27]. In addition to the RCT, a cohort study will be conducted that will assess changes in self-reported success in treating people with CFS and practice behaviours from baseline to follow-up for both groups combined.

Eligibility criteria

Australian allied health professionals (e.g., Psychologists, Exercise Physiologists, Physiotherapists, Occupational Therapists) will be randomly allocated to either the education group (immediate access to the online education program) or to a wait-list control group. People will be eligible for inclusion in the trial if they are a fully registered, allied health professional. Individuals who are not currently practicing will be excluded.

Recruitment

One hundred and eighty allied health professionals will be recruited via advertisements published in continuing professional development (CPD) calendars or newsletters of professional organisations, or distributed to existing mailing lists of appropriate organisations (e.g., Exercise and Sports Science Australia, Australian Physiotherapy Association, Australian Psychology Society, Australian Clinical Psychology Association, Occupational Therapy Australia). The recruitment notices and advertisements will contain a hyperlink that when accessed will provide information about the study and allow the individual to provide

consent if wishing to participate. Those consenting to participate will then be contacted by an experimenter with further instructions regarding the trial. Upon entering the study, the participant is allocated a participant identification code. To protect the participants' privacy, the outcome data is kept in a separate password protected file from the document containing the participants' names and identification codes. All documents related to the study are stored on a restricted access server in password-protected files as per UNSW HREC requirements.

Participant recruitment will start in September 2016.

Sample size calculation

A total sample of 128 participants is required to detect a moderate effect size ($d = 0.5$) of improvement in clinician knowledge of CFS management and confidence to implement evidence-based CFS interventions, with a power of 80% and a 2-tailed alpha of 0.05. To account for a potential attrition rate of 30% we intend to recruit 180 participants. These estimates of attrition rate and effect size are based on a similar previous study investigating online education for health professionals[22].

Randomisation

Participants will be randomly allocated to the education or wait-list control group after consenting to participate. Randomisation will be conducted by an investigator not involved in recruitment or analysis of data to ensure concealment of allocation. A computer-generated random number sequence with randomly permuted block sizes of 2 – 6 will be used to ensure a balance between groups whilst different allied health professions are successively enrolled.

Intervention

The online education program is an interactive, self-paced online activity that has been developed from a CFS Treatment Manual previously created, and tested for efficacy, by the

research group[7, 28]. The content contains an introduction and seven modules that include information on CFS symptoms, assessment and diagnosis and detailed descriptions of interventions used to manage CFS symptoms, as well as material on conditions that may occur secondary to fatigue (e.g. reduced mood, anxiety, etc.). The remaining modules cover: psychoeducation, activity pacing and GET, interventions for sleep disturbance, interventions for cognitive disturbance (e.g., cognitive remediation), and interventions for mood, anxiety and emotion coping. Intervention adherence will be tracked automatically by using the online platform to provide data on total time spent on the whole intervention, as well as time spent on each module, and on integrated assessment tasks and other facets of the online education program. To reduce contamination each participant has an individual password to access the online education program and are asked not to share this access by providing their password to others. They must also be enrolled into the program by the experimenter (and are subsequently un-enrolled once they have received 4-weeks access to the program). Furthermore, feedback regarding correct responses to the outcome measures (i.e., the MCQs and case vignettes) is not provided therefore cannot be shared between participants.

Table 1. Intervention description using the Template for Intervention Description and Replication (TIDieR) checklist.

Brief name	**Online education program for allied health professionals on CFS and evidence-based CFS interventions**
Why	The intervention has been designed based on a manual developed by the research group that drew on Cochrane reviews of CBT and GET interventions for CFS. Additionally, a large review of internet-based education programs indicates online education interventions are as effective as traditional training methods and have the advantage of being easily accessible[19].
What materials	The online education program is presented as a mix of text, audiovisual resources (including training videos) and interactive activities using the Smart Sparrow platform: https://www.smartsparrow.com.
What procedures	A number of modules are presented in the online education program as outlined below:

	Introduction ▪ Defines chronic fatigue states (e.g., post cancer fatigue) ▪ Fatigue assessment tools Module 1: Psychoeducation ▪ Rationale underlying the treatment approach Module 2: Activity pacing and graded exercise therapy ▪ Activity pacing ▪ Gradual progression of physical activities (GET) Module 3: Interventions for sleep-wake cycle disturbance ▪ Symptoms of sleep-wake cycle disturbance ▪ Sleep hygiene and CBT interventions for sleep-wake cycle disturbance Module 4: Interventions for neurocognitive disturbance ▪ Pacing of cognitive activities ▪ Gradual progression of cognitive activities (CET) Module 5: Interventions for mood disturbance ▪ How to distinguish between depression and chronic fatigue states ▪ Psychoeducation for mood disturbance ▪ CBT intervention for mood disturbance Module 6: Interventions for anxiety ▪ Anxiety symptoms ▪ CBT interventions for anxiety Module 7: Interventions for coping ▪ Effective coping strategies
Who provided	The online education program was designed and developed by five clinical psychologists, one research psychologist, five exercise physiologists and a medical specialist, all with significant clinical experience in treating people with chronic fatigue states.
How	The online education program is delivered individually as a self-paced online activity.
Where	Participants may access the online education program wherever they have a device with online access.
When and how much	Each participant will have access to the online education program for a duration of four weeks. The intervention is self-paced. The activity will collect data on how long participants spend on each module and assessment activity.
Tailoring	All participants will receive the same content.

Control group

The wait-list control group will be given access to the online education program immediately after completing the post-intervention assessment measures, which will be 4 to 5 weeks after completion of the baseline assessment measures.

Outcomes

All outcomes (with the exception of adherence to and satisfaction with the online education activity) will be determined by participants completing an online questionnaire and assessment at three time points. Both groups will complete the outcome measures at baseline (week 0) and post-intervention (week 4-5), while the follow-up measures will be completed in week 12 for the education group and week 16 for the wait-list control group (i.e., 8 weeks after cessation of access to the online education for both groups). Adherence to and satisfaction with the online education program will be collected as Post-assessment for the Education group only. In addition, information regarding profession type of the individual and years of practice will be collected to determine profession and level of professional experience.

RCT study

The primary outcome measures will be:

1. Participants' knowledge about CFS and CFS interventions measured at post intervention compared with baseline. Multiple choice and short answer questions, integrated with case vignettes, will test participants' knowledge about CFS symptoms, differential diagnosis, CFS management strategies and interventions (CBT and GET), and interventions for conditions that commonly arise secondary to fatigue (reduced mood and anxiety).
2. Participants' self-reported confidence in their knowledge of CFS and confidence in their clinical skills to implement evidence-based CFS interventions. This part of the questionnaire requires participants to rate their confidence in their knowledge and clinical skills related to CFS using a 5-point Likert scale ("not at all confident", "not very confident", "somewhat confident", "confident" and "very confident").

These measures have been constructed by an expert research group consisting of physicians, exercise physiologists and clinical psychologists and designed to test knowledge across the range of allied health professions.

Secondary outcome measures

The secondary outcome measures will be:

1. The retention of knowledge about CFS and CFS interventions, and confidence of participants' in their clinical skills, across the follow up period subsequent to the post-intervention assessment. This data will be collected for the Education group only.
2. Adherence to, and satisfaction with, the education activity. This data will be collected for the Education group only. Intervention adherence will be tracked using in-built features of the online education platform, which will monitor: time spent in total on the activity, time spent on each module of the activity and engagement in integrated formative assessment tasks. In the post-intervention assessment, participants will be asked to rate their agreement with a number of statements related to their satisfaction with the online education activity. This will be done using a 5-point Likert scale anchored at one end with "strongly disagree" and at the other end with "strongly agree". Open-ended responses will also be collected.

Cohort study outcomes

Primary outcome measures are assessed at baseline and follow-up, and are:

1. Participants' self-reported success in treating people with CFS. This part of the questionnaire requires participants to rate their level of success in treating people with CFS using a 5-point Likert scale, anchored at one end with "completely unsuccessful" and at the other end with "completely successful".

2. Practice behaviours as evidenced by participants' self-reported proportion of clinical practice devoted to people with CFS. This part of the questionnaire requires the participant to indicate the percentage of their clinical practice that is devoted to management of people with CFS, for example the proportion of their clientele who have CFS, to determine levels of service provision.

Analysis of outcomes

Between group differences at baseline (i.e., education group versus wait-list control group) will be determined using independent t-tests for the knowledge assessment (primary outcome measure) and Mann-Whitney U tests for the Likert scale ratings (secondary outcome measures). To determine if the group receiving the online education program improve in knowledge and confidence related to the management of CFS, compared to the wait-list control group, an intention-to-treat analysis will be used. Group differences in change scores from baseline to post-intervention will be analysed with independent t-tests for the knowledge assessment, and with Mann-Whitney U tests for the measure of clinician confidence. Short answer responses in the assessments will be graded in duplicate by blinded markers, using standardised answer criteria. Open-ended responses regarding participant satisfaction with the online education will be coded and analysed thematically using NVivo software. Descriptive statistics will be generated from Likert scale responses to the questionnaire items regarding satisfaction with the intervention. Similarly, descriptive statistics will be generated for the total time spent on the online education program, time spent on each module, total time spent on the integrated formative assessment tasks, and responses on these tasks for each professional group. All statistical analyses will be conducted on de-identified data using SPSS software and the experimenter responsible for data analysis will be blinded to group allocation.

For the cohort study, retention of knowledge will be assessed using a dependent t-test comparing post-intervention and follow-up assessment scores for the education group only. An intention-to-treat analysis will not be used in this instance so that retention of learning is not artificially inflated. To provide a preliminary indication of the impact of the intervention on clinical practice we will compare the change in measures of practice behaviour (i.e., proportion of clinical practice devoted to the management of people with CFS) from baseline to follow-up in cohort study with the outcome measures for both groups combined. The range in proportion of clinical practice devoted to people with CFS at baseline for both groups will also be described to account for potential biases in sampling. This pragmatic approach should ensure a sufficient sample at follow up.

DISCUSSION

Given the serious and debilitating nature of CFS and the absence of curative treatments, it is unfortunate that there has been limited uptake of evidence-based treatments aimed at managing symptoms and improving patient function. To our knowledge there have been no studies to date that have investigated the impact of an online education program on clinician knowledge and skills related to CFS management by allied health professionals. This trial aims to evaluate if an online education program improves clinicians' knowledge and confidence to treat patients with CFS.

Reflective of the multidisciplinary nature of CBT/GET interventions, the education intervention is being trialled across a range of allied health professions who will have different background experience with regard to the two major aspects of the intervention. Learning analytics within the intervention, and performance on specific sets of questions within the trial assessments, will identify the extent to which learner background has

influenced performance. Coupled with feedback from the trial participants regarding their satisfaction and learning preferences, it is possible on the elearning platform used in this trial to refine activities by incorporating adaptive features particular to groups or individuals to tailor content and feedback.

The cohort study component of the trial will generate preliminary evidence to determine if the intervention has an impact on clinical practice behaviours, which would also be amenable to further investigation using an optimised learning intervention. Given the possibility of convenience sampling of allied health professionals further investigation regarding the efficacy of the intervention on a sample that have yet to formulate opinions regarding intervention for CFS would also be valuable (e.g., implemented within a tertiary allied health training program or mandated for all staff within a health professional service). The readily distributable online education intervention has the potential to improve the capacity of a range of allied health professionals to provide effective interventions for people with CFS.

ETHICS AND DISSEMINATION

The study protocol has been approved by the Human Research Ethics Committee at UNSW, Australia (approval number HC16419). The results of this trial will be disseminated via peer reviewed journal articles, and presentations at scientific conferences and meetings.

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AUTHORS CONTRIBUTIONS

BB, AL, CS and SL conceived the study. SL, BB, CS, SC and AL initiated the study design and JC and TB assisted with implementation. SL, BB, CS, SC and AL are grant holders. SL and BB are conducting the primary statistical analysis. All authors contributed to the refinement of the study protocol and approved the final manuscript. We would also like to acknowledge Gary Goldie's technical assistance with the Smart Sparrow platform.

FUNDING STATEMENT

This work is supported by JJ Mason & HS Williams Memorial Foundation (Grant number: MAS2015F040)

COMPETING INTERESTS

None of the authors having competing interests to declare.

LEGENDS

Figure 1. Trial design.

Table 1. Intervention description using the Template for Intervention Description and Replication (TIDieR) checklist.

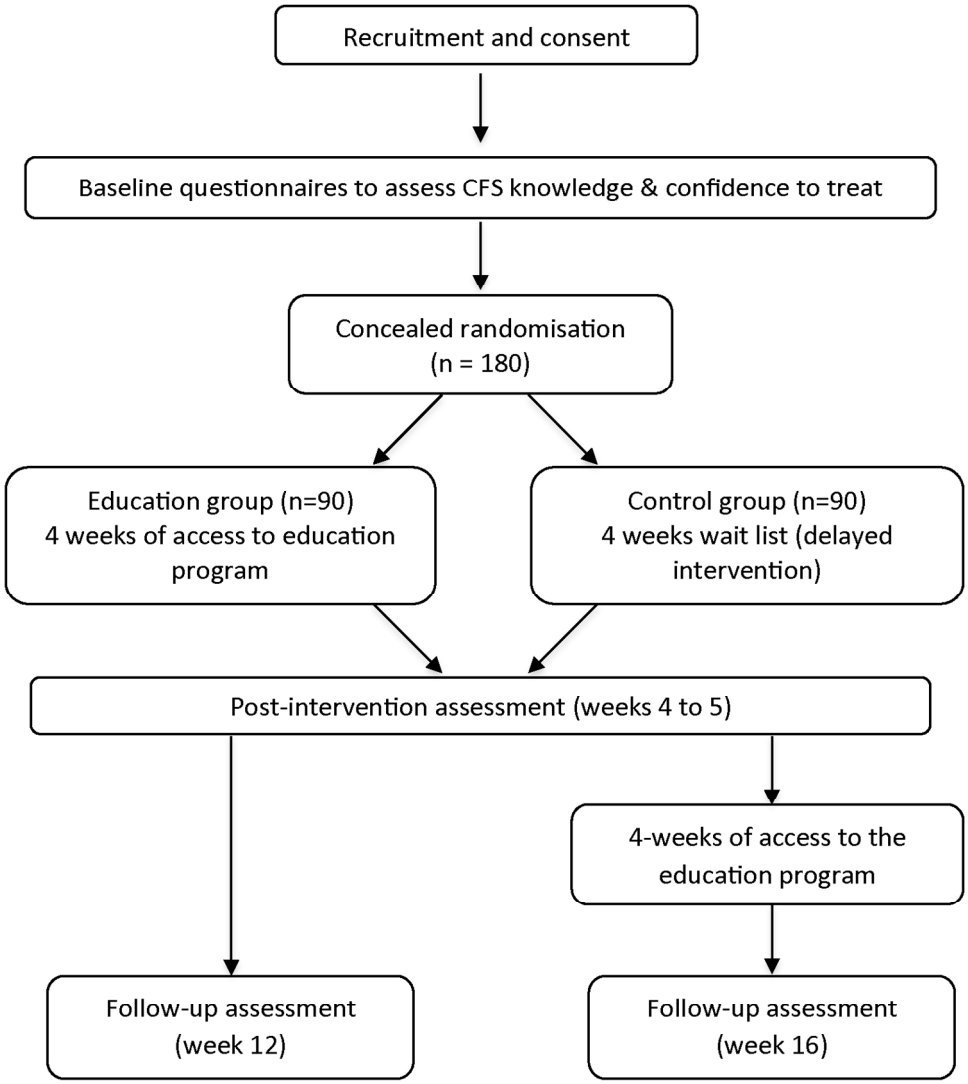

Figure 1. Trial design.

139x156mm (300 x 300 DPI)

SPIRIT
STANDARD PROTOCOL ITEMS: RECOMMENDATIONS FOR INTERVENTIONAL TRIALS

SPIRIT 2013 Checklist: Recommended items to address in a clinical trial protocol and related documents*

Section/item	Item No	Description	
Administrative information			
Title	1	Descriptive title identifying the study design, population, interventions, and, if applicable, trial acronym	P 1
Trial registration	2a	Trial identifier and registry name. If not yet registered, name of intended registry	P 3
	2b	All items from the World Health Organization Trial Registration Data Set	P 3
Protocol version	3	Date and version identifier	
Funding	4	Sources and types of financial, material, and other support	P 17
Roles and responsibilities	5a	Names, affiliations, and roles of protocol contributors	P1, P 17
	5b	Name and contact information for the trial sponsor	P 17
	5c	Role of study sponsor and funders, if any, in study design; collection, management, analysis, and interpretation of data; writing of the report; and the decision to submit the report for publication, including whether they will have ultimate authority over any of these activities	N/A
	5d	Composition, roles, and responsibilities of the coordinating centre, steering committee, endpoint adjudication committee, data management team, and other individuals or groups overseeing the trial, if applicable (see Item 21a for data monitoring committee)	P 17
Introduction			
Background and rationale	6a	Description of research question and justification for undertaking the trial, including summary of relevant studies (published and unpublished) examining benefits and harms for each intervention	P4-6
	6b	Explanation for choice of comparators	P 6
Objectives	7	Specific objectives or hypotheses	P 6
Trial design	8	Description of trial design including type of trial (eg, parallel group, crossover, factorial, single group), allocation ratio, and framework (eg, superiority, equivalence, noninferiority, exploratory)	P 7

Methods: Participants, interventions, and outcomes			
Study setting	9	Description of study settings (eg, community clinic, academic hospital) and list of countries where data will be collected. Reference to where list of study sites can be obtained	P10, table
Eligibility criteria	10	Inclusion and exclusion criteria for participants. If applicable, eligibility criteria for study centres and individuals who will perform the interventions (eg, surgeons, psychotherapists)	P 7
Interventions	11a	Interventions for each group with sufficient detail to allow replication, including how and when they will be administered	P8-10
	11b	Criteria for discontinuing or modifying allocated interventions for a given trial participant (eg, drug dose change in response to harms, participant request, or improving/worsening disease)	NA
	11c	Strategies to improve adherence to intervention protocols, and any procedures for monitoring adherence (eg, drug tablet return, laboratory tests)	P 11
	11d	Relevant concomitant care and interventions that are permitted or prohibited during the trial	NA
Outcomes	12	Primary, secondary, and other outcomes, including the specific measurement variable (eg, systolic blood pressure), analysis metric (eg, change from baseline, final value, time to event), method of aggregation (eg, median, proportion), and time point for each outcome. Explanation of the clinical relevance of chosen efficacy and harm outcomes is strongly recommended	P10-12
Participant timeline	13	Time schedule of enrolment, interventions (including any run-ins and washouts), assessments, and visits for participants. A schematic diagram is highly recommended (see Figure)	P 7, Figure1
Sample size	14	Estimated number of participants needed to achieve study objectives and how it was determined, including clinical and statistical assumptions supporting any sample size calculations	P 8
Recruitment	15	Strategies for achieving adequate participant enrolment to reach target sample size	P7-8
Methods: Assignment of interventions (for controlled trials)			
Allocation:			
Sequence generation	16a	Method of generating the allocation sequence (eg, computer-generated random numbers), and list of any factors for stratification. To reduce predictability of a random sequence, details of any planned restriction (eg, blocking) should be provided in a separate document that is unavailable to those who enrol participants or assign interventions	P 8

Allocation concealment mechanism	16b	Mechanism of implementing the allocation sequence (eg, central telephone; sequentially numbered, opaque, sealed envelopes), describing any steps to conceal the sequence until interventions are assigned	P 7
Implementation	16c	Who will generate the allocation sequence, who will enrol participants, and who will assign participants to interventions	P 8
Blinding (masking)	17a	Who will be blinded after assignment to interventions (eg, trial participants, care providers, outcome assessors, data analysts), and how	P 8
	17b	If blinded, circumstances under which unblinding is permissible, and procedure for revealing a participant's allocated intervention during the trial	NA
Methods: Data collection, management, and analysis			
Data collection methods	18a	Plans for assessment and collection of outcome, baseline, and other trial data, including any related processes to promote data quality (eg, duplicate measurements, training of assessors) and a description of study instruments (eg, questionnaires, laboratory tests) along with their reliability and validity, if known. Reference to where data collection forms can be found, if not in the protocol	P11-12
	18b	Plans to promote participant retention and complete follow-up, including list of any outcome data to be collected for participants who discontinue or deviate from intervention protocols	P 9
Data management	19	Plans for data entry, coding, security, and storage, including any related processes to promote data quality (eg, double data entry; range checks for data values). Reference to where details of data management procedures can be found, if not in the protocol	P 8
Statistical methods	20a	Statistical methods for analysing primary and secondary outcomes. Reference to where other details of the statistical analysis plan can be found, if not in the protocol	P 13
	20b	Methods for any additional analyses (eg, subgroup and adjusted analyses)	NA
	20c	Definition of analysis population relating to protocol non-adherence (eg, as randomised analysis), and any statistical methods to handle missing data (eg, multiple imputation)	P13-14
Methods: Monitoring			
Data monitoring	21a	Composition of data monitoring committee (DMC); summary of its role and reporting structure; statement of whether it is independent from the sponsor and competing interests; and reference to where further details about its charter can be found, if not in the protocol. Alternatively, an explanation of why a DMC is not needed	NA

	21b	Description of any interim analyses and stopping guidelines, including who will have access to these interim results and make the final decision to terminate the trial	NA
Harms	22	Plans for collecting, assessing, reporting, and managing solicited and spontaneously reported adverse events and other unintended effects of trial interventions or trial conduct	NA
Auditing	23	Frequency and procedures for auditing trial conduct, if any, and whether the process will be independent from investigators and the sponsor	NA
Ethics and dissemination			
Research ethics approval	24	Plans for seeking research ethics committee/institutional review board (REC/IRB) approval	P 3
Protocol amendments	25	Plans for communicating important protocol modifications (eg, changes to eligibility criteria, outcomes, analyses) to relevant parties (eg, investigators, REC/IRBs, trial participants, trial registries, journals, regulators)	
Consent or assent	26a	Who will obtain informed consent or assent from potential trial participants or authorised surrogates, and how (see Item 32)	P 7
	26b	Additional consent provisions for collection and use of participant data and biological specimens in ancillary studies, if applicable	NA
Confidentiality	27	How personal information about potential and enrolled participants will be collected, shared, and maintained in order to protect confidentiality before, during, and after the trial	P 8
Declaration of interests	28	Financial and other competing interests for principal investigators for the overall trial and each study site	P 18
Access to data	29	Statement of who will have access to the final trial dataset, and disclosure of contractual agreements that limit such access for investigators	
Ancillary and post-trial care	30	Provisions, if any, for ancillary and post-trial care, and for compensation to those who suffer harm from trial participation	NA
Dissemination policy	31a	Plans for investigators and sponsor to communicate trial results to participants, healthcare professionals, the public, and other relevant groups (eg, via publication, reporting in results databases, or other data sharing arrangements), including any publication restrictions	P 3
	31b	Authorship eligibility guidelines and any intended use of professional writers	NA
	31c	Plans, if any, for granting public access to the full protocol, participant-level dataset, and statistical code	NA

Appendices

Informed consent materials	32	Model consent form and other related documentation given to participants and authorised surrogates	NA online
Biological specimens	33	Plans for collection, laboratory evaluation, and storage of biological specimens for genetic or molecular analysis in the current trial and for future use in ancillary studies, if applicable	NA

*It is strongly recommended that this checklist be read in conjunction with the SPIRIT 2013 Explanation & Elaboration for important clarification on the items. Amendments to the protocol should be tracked and dated. The SPIRIT checklist is copyrighted by the SPIRIT Group under the Creative Commons "Attribution-NonCommercial-NoDerivs 3.0 Unported" license.

BMJ Open

A randomised controlled trial of online continuing education for health professionals to improve the management of chronic fatigue syndrome: A study protocol.

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2016-014133.R3
Article Type:	Protocol
Date Submitted by the Author:	07-Mar-2017
Complete List of Authors:	Li, Sophie; University of New South Wales, School of Medical Sciences; University of New South Wales, School of Psychology Sandler, Carolina; University of New South Wales, School of Medical Sciences Casson, Sally; University of New South Wales, School of Medical Sciences Cassar, Joanne; University of New South Wales, School of Medical Sciences Bogg, Tina; University of New South Wales, School of Medical Sciences Lloyd, Andrew; University of New South Wales, The Kirby Institute Barry, Benjamin; The University of New South Wales, School of Medical Sciences; University of Queensland, School of Clinical Medicine
Primary Subject Heading:	Medical education and training
Secondary Subject Heading:	Rehabilitation medicine
Keywords:	chronic fatigue syndrome, cognitive behaviour therapy, graded exercise therapy, education, online, randomised controlled trial

A randomised controlled trial of online continuing education for health professionals to improve the management of chronic fatigue syndrome: A study protocol.

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Word count: 2893

Key words: chronic fatigue syndrome, cognitive behaviour therapy, graded exercise therapy, education, online, randomised controlled trial

ABSTRACT

Introduction

Chronic fatigue syndrome (CFS) is a serious and debilitating illness that affects between 0.2-2.6% of the world's population. Although there is Level One evidence of the benefit of cognitive behavior therapy (CBT) and graded exercise therapy (GET) for some people with CFS, uptake of these interventions is low or at best untimely. This can be partly attributed to poor clinician awareness and knowledge of CFS and related CBT and GET interventions. This trial aims to evaluate the effect of participation in an online education program, compared with a wait-list control group, on allied health professionals' knowledge about evidence-based CFS interventions and their levels of confidence to engage in the dissemination of these interventions.

Methods and analysis

A randomised controlled trial consisting of 180 consenting allied health professionals will be conducted. Participants will be randomised into an intervention group (n=90) that will receive access to the online education program, or a wait-list control group (n=90). The primary outcome will be knowledge and clinical reasoning skills regarding CFS and its management, measured at baseline, post-intervention and follow-up. Secondary outcomes include: 1) self-reported confidence in knowledge and clinical reasoning skills related to CFS, and 2) self-reported success in the management of people with CFS. Retention of knowledge, satisfaction with the online education program and the influence of the education program on clinical practice behaviour will also be assessed in a cohort study design with participants from the intervention and control groups combined.

Ethics and dissemination

The study protocol has been approved by the Human Research Ethics Committee at The University of New South Wales (approval number HC16419). Results will be disseminated via peer reviewed journal articles, and presentations at scientific conferences and meetings.

Trial registration

Trial protocol was registered with the Australian and New Zealand Clinical Trials Registry (ACTRN12616000296437p) on 7 March 2016.

Strengths:

- Randomised controlled trial
- Objective and subjective assessment measures
- Translation of evidence-based interventions to practice
- Engaging multiple allied health professions

Limitations:

- Follow-up measurements made on a cohort rather than intervention and control groups
- Actual impact on practice is assessed only by clinician report and in the short term
- Trial recruitment is confined to Australia
- Customised assessments for this study have not previously been validated

INTRODUCTION

Chronic fatigue syndrome (CFS) refers to the presence of persistent and severe fatigue that is accompanied by musculo-skeletal pain, neurocognitive difficulties, in addition to sleep and mood disturbances, and cannot be accounted for by a medical condition[1]. It is a serious and debilitating illness that affects between 0.2-2.6% of the world's population[2]. Cochrane reviews of both cognitive behaviour therapy (CBT)[3] and graded exercise therapy (GET)[4] provide Level One evidence of their benefits for people with CFS. More than 20 randomised controlled trials by independent researchers examining the effectiveness of CBT or GET across separate patient groups and in various geographical locations have found moderately beneficial effects of these interventions for CFS, including significantly reduced levels of fatigue, functional impairment, depression and anxiety, in group-wise outcome analyses (for a review see[5]). There is also recent evidence that combining CBT and GET may be more effective than CBT alone[6]. When applied appropriately the interventions are not associated with harm[4, 7, 8], and the beneficial effects vary in magnitude from negligible to clinically significant[3, 4] (This conclusion relates to patients who are able to attend a clinic and may not generalise to more disabled patients). These interventions have also proved generally effective in routine clinical practice[9]. In the absence of a clear understanding of the underlying pathophysiology of CFS, or curative treatments, as these are the only evidence-based interventions aimed at managing symptoms and improving function, they should be readily available[10]. Yet uptake of evidence-based CFS management programs delivered by allied health professionals such as psychologists, exercise physiologists and physiotherapists is low[11, 12]. Recent studies have shown that gaps between research and practice are at least partially due to allied health professionals lacking the knowledge and skills to provide appropriate care[13, 14], and potentially also the effects of the controversy regarding the PACE trial analysis[15].

For several reasons it is crucial that allied health professionals have the capacity to provide evidence-based CBT and GET interventions to patients with CFS. First, it should be a patient's right that interventions proven to assist in the management of their symptoms are readily available. Second, it is widely acknowledged that over-exertion can lead to exacerbation of fatigue symptoms (for examples see[16, 17]), thus inappropriate prescription of physical and cognitive activities will result in poor treatment outcome. Many patients and allied health professionals incorrectly assume GET involves the development of a traditional exercise program (this is an easy mistake to make given the potentially misleading term: *graded exercise therapy*) that requires marked physical exertion, which should be continued regardless of increasing symptoms. However, after appropriate day-to-day pacing of regular activities has been established - that is, establishing a daily or weekly schedule of activities that does not exceed the individual's energy thresholds[7] - GET merely commences with conservative incremental increases in the duration of daily physical activities, including incidental tasks such as domestic chores. This is followed by gradual progression to more structured exercise, such as walking, which is introduced and cautiously increased in a graded fashion, generally at levels far below physical activity guidelines for the general population[7]. Thus, to provide safe and effective GET for people with CFS some clinicians may need to recalibrate their notions of exercise. The implementation of GET as part of an intervention for people with CFS subsequent to the establishment of appropriate pacing of activities is important because activity pacing alone does not consistently provide benefit[7, 18].

Finally, and very importantly, many health professionals have outdated views on the aetiology of CFS, which can result in the use of inappropriate interventions and hence patient

frustration. Rooted in historically dismissive views from some clinicians is a concern of some people with CFS that the advocacy of a psychological intervention, such as CBT, implies that their illness is "all in their head" and not a real disease. Education of clinicians about CFS and the role of CBT is an important step to help address such misunderstandings.

Improving allied health professional knowledge via online continuing education activities has been widely documented[19 20]. Yet there has been very little research into interventions that aim to influence allied health professional knowledge and practice in relation to CFS. One study investigated whether community health care centres were able to implement and sustain a CBT intervention for people with CFS by using an implementation manual[21]. They found that while patients showed an improvement in fatigue severity and physical function, health professionals required considerable external support from the authors of the study for successful implementation of the manual. Online education programs are an alternative method to improve health professional knowledge and practice, as has been demonstrated in other areas of health care (for example,[22, 23]). While the impact of online educational interventions has been investigated in some areas of health care (for example,[22-24]), none, to our knowledge, have investigated the impact of online educational activities on CFS management. The aim of this trial is to evaluate the effect of participation in an online education program on allied health professionals' knowledge about evidence-based CFS interventions and their levels of confidence to deliver these interventions, compared with a wait-list control group. Satisfaction with the online education program will also be assessed, as will retention of knowledge, for the intervention group only. The influence of the education program on clinical practice behavior will be assessed in a cohort study design with participants pooled from the intervention and wait-list control groups.

METHODS AND ANALYSIS:

Trial design

A randomised controlled trial will be conducted in accordance with the Consolidated Standards of Reporting Trials (CONSORT) statement[25] as shown in Figure 1. The trial design was developed and is reported according to the Recommendations for Interventional Trials (SPIRIT) statement[26] and the education intervention is described according to the Template for Intervention Description and Replication (TIDieR) checklist[27]. In addition to the RCT, a cohort study will be conducted that will assess changes in self-reported success in the management of people with CFS and practice behaviours from baseline to follow-up for both groups combined.

Eligibility criteria

Australian allied health professionals (e.g., Psychologists, Exercise Physiologists, Physiotherapists, Occupational Therapists) will be randomly allocated to either the education group (immediate access to the online education program) or to a wait-list control group. People will be eligible for inclusion in the trial if they are a fully registered, allied health professional. Individuals who are not currently practicing will be excluded.

Recruitment

One hundred and eighty allied health professionals will be recruited via advertisements published in continuing professional development (CPD) calendars or newsletters of professional organisations, or distributed to existing mailing lists of appropriate organisations (e.g., Exercise and Sports Science Australia, Australian Physiotherapy Association, Australian Psychology Society, Australian Clinical Psychology Association, Occupational Therapy Australia). The recruitment notices and advertisements will contain a hyperlink that when accessed will provide information about the study and allow the individual to provide

consent if wishing to participate. Those consenting to participate will then be contacted by an experimenter with further instructions regarding the trial. Upon entering the study, the participant is allocated a participant identification code. To protect the participants' privacy, the outcome data is kept in a separate password protected file from the document containing the participants' names and identification codes. All documents related to the study are stored on a restricted access server in password-protected files as per UNSW HREC requirements.

Participant recruitment will start in September 2016.

Sample size calculation

A total sample of 128 participants is required to detect a moderate effect size ($d = 0.5$) of improvement in clinician knowledge of CFS management and confidence to implement evidence-based CFS interventions, with a power of 80% and a 2-tailed alpha of 0.05. To account for a potential attrition rate of 30% we intend to recruit 180 participants. These estimates of attrition rate and effect size are based on a similar previous study investigating online education for health professionals[22].

Randomisation

Participants will be randomly allocated to the education or wait-list control group after consenting to participate. Randomisation will be conducted by an investigator not involved in recruitment or analysis of data to ensure concealment of allocation. A computer-generated random number sequence with randomly permuted block sizes of 2 – 6 will be used to ensure a balance between groups whilst different allied health professions are successively enrolled.

Intervention

The online education program is an interactive, self-paced online activity that has been developed from a CFS Treatment Manual previously created, and tested for efficacy, by the

research group[7, 28]. The content contains an introduction and seven modules that include information on CFS symptoms, assessment and diagnosis and detailed descriptions of interventions used to manage CFS symptoms, as well as material on conditions that may occur secondary to fatigue (e.g. reduced mood, anxiety, etc.). The remaining modules cover: psychoeducation, activity pacing and GET, interventions for sleep disturbance, interventions for cognitive disturbance (e.g., cognitive remediation), and interventions for mood, anxiety and emotion coping. Intervention adherence will be tracked automatically by using the online platform to provide data on total time spent on the whole intervention, as well as time spent on each module, and on integrated assessment tasks and other facets of the online education program. To reduce contamination each participant has an individual password to access the online education program and are asked not to share this access by providing their password to others. They must also be enrolled into the program by the experimenter (and are subsequently un-enrolled once they have received 4-weeks access to the program). Furthermore, feedback regarding correct responses to the outcome measures (i.e., the MCQs and case vignettes) is not provided therefore cannot be shared between participants.

Table 1. Intervention description using the Template for Intervention Description and Replication (TIDieR) checklist.

Brief name	**Online education program for allied health professionals on CFS and evidence-based CFS interventions**
Why	The intervention has been designed based on a manual developed by the research group that drew on Cochrane reviews of CBT and GET interventions for CFS. Additionally, a large review of internet-based education programs indicates online education interventions are as effective as traditional training methods and have the advantage of being easily accessible[19].
What materials	The online education program is presented as a mix of text, audiovisual resources (including training videos) and interactive activities using the Smart Sparrow platform: https://www.smartsparrow.com.
What procedures	A number of modules are presented in the online education program as outlined below:

	Introduction ▪ Defines chronic fatigue states (e.g., post cancer fatigue) ▪ Fatigue assessment tools Module 1: Psychoeducation ▪ Rationale underlying the intervention approach Module 2: Activity pacing and graded exercise therapy ▪ Activity pacing ▪ Gradual progression of physical activities (GET) Module 3: Interventions for sleep-wake cycle disturbance ▪ Symptoms of sleep-wake cycle disturbance ▪ Sleep hygiene and CBT interventions for sleep-wake cycle disturbance Module 4: Interventions for neurocognitive disturbance ▪ Pacing of cognitive activities ▪ Gradual progression of cognitive activities (CET) Module 5: Interventions for mood disturbance ▪ How to distinguish between depression and chronic fatigue states ▪ Psychoeducation for mood disturbance ▪ CBT intervention for mood disturbance Module 6: Interventions for anxiety ▪ Anxiety symptoms ▪ CBT interventions for anxiety Module 7: Interventions for coping ▪ Effective coping strategies
Who provided	The online education program was designed and developed by five clinical psychologists, one research psychologist, five exercise physiologists and a medical specialist, all with significant clinical experience in the management of people with chronic fatigue states.
How	The online education program is delivered individually as a self-paced online activity.
Where	Participants may access the online education program wherever they have a device with online access.
When and how much	Each participant will have access to the online education program for a duration of four weeks. The intervention is self-paced. The activity will collect data on how long participants spend on each module and assessment activity.
Tailoring	All participants will receive the same content.

Control group

The wait-list control group will be given access to the online education program immediately after completing the post-intervention assessment measures, which will be 4 to 5 weeks after completion of the baseline assessment measures.

Outcomes

All outcomes (with the exception of adherence to and satisfaction with the online education activity) will be determined by participants completing an online questionnaire and assessment at three time points. Both groups will complete the outcome measures at baseline (week 0) and post-intervention (week 4-5), while the follow-up measures will be completed in week 12 for the education group and week 16 for the wait-list control group (i.e., 8 weeks after cessation of access to the online education for both groups). Adherence to and satisfaction with the online education program will be collected at Post-assessment for the Education group only. In addition, information regarding profession type of the individual and years of practice will be collected to determine profession and level of professional experience.

RCT study

The primary outcome measures will be:

1. Participants' knowledge about CFS and CFS interventions measured at post intervention compared with baseline. Multiple choice and short answer questions, integrated with case vignettes, will test participants' knowledge about CFS symptoms, differential diagnosis, CFS management strategies and interventions (CBT and GET), and interventions for conditions that commonly arise secondary to fatigue (reduced mood and anxiety).
2. Participants' self-reported confidence in their knowledge of CFS and confidence in their clinical skills to implement evidence-based CFS interventions. This part of the questionnaire requires participants to rate their confidence in their knowledge and clinical skills related to CFS using a 5-point Likert scale ("not at all confident", "not very confident", "somewhat confident", "confident" and "very confident").

These measures have been constructed by an expert research group consisting of physicians, exercise physiologists and clinical psychologists and designed to test knowledge across the range of allied health professions.

Secondary outcome measures

The secondary outcome measures will be:

1. The retention of knowledge about CFS and CFS interventions, and confidence of participants' in their clinical skills, across the follow up period subsequent to the post-intervention assessment. This data will be collected for the Education group only.
2. Adherence to, and satisfaction with, the education activity. This data will be collected for the Education group only. Intervention adherence will be tracked using in-built features of the online education platform, which will monitor: time spent in total on the activity, time spent on each module of the activity and engagement in integrated formative assessment tasks. In the post-intervention assessment, participants will be asked to rate their agreement with a number of statements related to their satisfaction with the online education activity. This will be done using a 5-point Likert scale anchored at one end with "strongly disagree" and at the other end with "strongly agree". Open-ended responses will also be collected.

Cohort study outcomes

Primary outcome measures are assessed at baseline and follow-up, and are:

1. Participants' self-reported success in the management of people with CFS. This part of the questionnaire requires participants to rate their level of success in the management of people with CFS using a 5-point Likert scale, anchored at one end with "completely unsuccessful" and at the other end with "completely successful".

2. Practice behaviours as evidenced by participants' self-reported proportion of clinical practice devoted to people with CFS. This part of the questionnaire requires the participant to indicate the percentage of their clinical practice that is devoted to management of people with CFS, for example the proportion of their clientele who have CFS, to determine levels of service provision.

Analysis of outcomes

Between group differences at baseline (i.e., education group versus wait-list control group) will be determined using independent t-tests for the knowledge assessment (primary outcome measure) and Mann-Whitney U tests for the Likert scale ratings (secondary outcome measures). To determine if the group receiving the online education program improve in knowledge and confidence related to the management of CFS, compared to the wait-list control group, an intention-to-treat analysis will be used. Group differences in change scores from baseline to post-intervention will be analysed with independent t-tests for the knowledge assessment, and with Mann-Whitney U tests for the measure of clinician confidence. Short answer responses in the assessments will be graded in duplicate by blinded markers, using standardised answer criteria. Open-ended responses regarding participant satisfaction with the online education will be coded and analysed thematically using NVivo software. Descriptive statistics will be generated from Likert scale responses to the questionnaire items regarding satisfaction with the intervention. Similarly, descriptive statistics will be generated for the total time spent on the online education program, time spent on each module, total time spent on the integrated formative assessment tasks, and responses on these tasks for each professional group. All statistical analyses will be conducted on de-identified data using SPSS software and the experimenter responsible for data analysis will be blinded to group allocation.

For the cohort study, retention of knowledge will be assessed using a dependent t-test comparing post-intervention and follow-up assessment scores for the education group only. An intention-to-treat analysis will not be used in this instance so that retention of learning is not artificially inflated. To provide a preliminary indication of the impact of the intervention on clinical practice we will compare the change in measures of practice behaviour (i.e., proportion of clinical practice devoted to the management of people with CFS) from baseline to follow-up in cohort study with the outcome measures for both groups combined. The range in proportion of clinical practice devoted to people with CFS at baseline for both groups will also be described to account for potential biases in sampling. This pragmatic approach should ensure a sufficient sample at follow up.

DISCUSSION

Given the serious and debilitating nature of CFS and the absence of curative treatments, it is unfortunate that there has been limited uptake of evidence-based interventions aimed at managing symptoms and improving patient function. To our knowledge there have been no studies to date that have investigated the impact of an online education program on clinician knowledge and skills related to CFS management by allied health professionals. This trial aims to evaluate if an online education program improves clinicians' knowledge and confidence in the management of patients with CFS.

Reflective of the multidisciplinary nature of CBT/GET interventions, the education intervention is being trialled across a range of allied health professions who will have different background experience with regard to the two major aspects of the intervention. Learning analytics within the intervention, and performance on specific sets of questions within the trial assessments, will identify the extent to which learner background has

influenced performance. Coupled with feedback from the trial participants regarding their satisfaction and learning preferences, it is possible on the elearning platform used in this trial to refine activities by incorporating adaptive features particular to groups or individuals to tailor content and feedback.

The cohort study component of the trial will generate preliminary evidence to determine if the intervention has an impact on clinical practice behaviours, which would also be amenable to further investigation using an optimised learning intervention. Given the possibility of convenience sampling of allied health professionals further investigation regarding the efficacy of the intervention on a sample that have yet to formulate opinions regarding intervention for CFS would also be valuable (e.g., implemented within a tertiary allied health training program or mandated for all staff within a health professional service). The readily distributable online education intervention has the potential to improve the capacity of a range of allied health professionals to provide effective interventions for people with CFS.

ETHICS AND DISSEMINATION

The study protocol has been approved by the Human Research Ethics Committee at UNSW, Australia (approval number HC16419). The results of this trial will be disseminated via peer reviewed journal articles, and presentations at scientific conferences and meetings.

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AUTHORS CONTRIBUTIONS

BB, AL, CS and SL conceived the study. SL, BB, CS, SC and AL initiated the study design and JC and TB assisted with implementation. SL, BB, CS, SC and AL are grant holders. SL and BB are conducting the primary statistical analysis. All authors contributed to the refinement of the study protocol and approved the final manuscript. We would also like to acknowledge Gary Goldie's technical assistance with the Smart Sparrow platform.

FUNDING STATEMENT

This work is supported by JJ Mason & HS Williams Memorial Foundation (Grant number: MAS2015F040)

COMPETING INTERESTS

None of the authors having competing interests to declare.

LEGENDS

Figure 1. Trial design.

Table 1. Intervention description using the Template for Intervention Description and Replication (TIDieR) checklist.

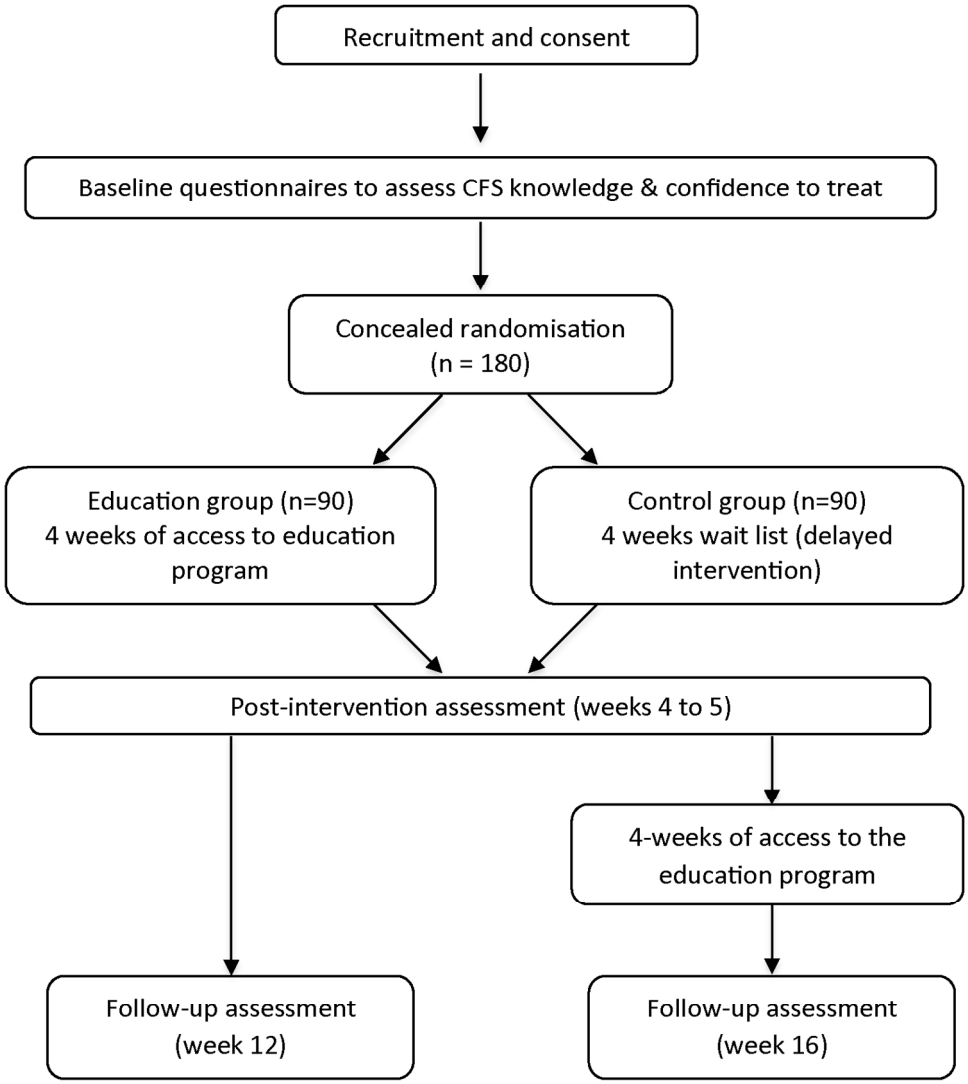

Figure 1. Trial design.

139x156mm (300 x 300 DPI)

SPIRIT
STANDARD PROTOCOL ITEMS: RECOMMENDATIONS FOR INTERVENTIONAL TRIALS

SPIRIT 2013 Checklist: Recommended items to address in a clinical trial protocol and related documents*

Section/item	Item No	Description	
Administrative information			
Title	1	Descriptive title identifying the study design, population, interventions, and, if applicable, trial acronym	P 1
Trial registration	2a	Trial identifier and registry name. If not yet registered, name of intended registry	P 3
	2b	All items from the World Health Organization Trial Registration Data Set	P 3
Protocol version	3	Date and version identifier	
Funding	4	Sources and types of financial, material, and other support	P 17
Roles and responsibilities	5a	Names, affiliations, and roles of protocol contributors	P1, P 17
	5b	Name and contact information for the trial sponsor	P 17
	5c	Role of study sponsor and funders, if any, in study design; collection, management, analysis, and interpretation of data; writing of the report; and the decision to submit the report for publication, including whether they will have ultimate authority over any of these activities	N/A
	5d	Composition, roles, and responsibilities of the coordinating centre, steering committee, endpoint adjudication committee, data management team, and other individuals or groups overseeing the trial, if applicable (see Item 21a for data monitoring committee)	P 17
Introduction			
Background and rationale	6a	Description of research question and justification for undertaking the trial, including summary of relevant studies (published and unpublished) examining benefits and harms for each intervention	P4-6
	6b	Explanation for choice of comparators	P 6
Objectives	7	Specific objectives or hypotheses	P 6
Trial design	8	Description of trial design including type of trial (eg, parallel group, crossover, factorial, single group), allocation ratio, and framework (eg, superiority, equivalence, noninferiority, exploratory)	P 7

Methods: Participants, interventions, and outcomes			
Study setting	9	Description of study settings (eg, community clinic, academic hospital) and list of countries where data will be collected. Reference to where list of study sites can be obtained	P10, table
Eligibility criteria	10	Inclusion and exclusion criteria for participants. If applicable, eligibility criteria for study centres and individuals who will perform the interventions (eg, surgeons, psychotherapists)	P 7
Interventions	11a	Interventions for each group with sufficient detail to allow replication, including how and when they will be administered	P8-10
	11b	Criteria for discontinuing or modifying allocated interventions for a given trial participant (eg, drug dose change in response to harms, participant request, or improving/worsening disease)	NA
	11c	Strategies to improve adherence to intervention protocols, and any procedures for monitoring adherence (eg, drug tablet return, laboratory tests)	P 11
	11d	Relevant concomitant care and interventions that are permitted or prohibited during the trial	NA
Outcomes	12	Primary, secondary, and other outcomes, including the specific measurement variable (eg, systolic blood pressure), analysis metric (eg, change from baseline, final value, time to event), method of aggregation (eg, median, proportion), and time point for each outcome. Explanation of the clinical relevance of chosen efficacy and harm outcomes is strongly recommended	P10-12
Participant timeline	13	Time schedule of enrolment, interventions (including any run-ins and washouts), assessments, and visits for participants. A schematic diagram is highly recommended (see Figure)	P 7, Figure1
Sample size	14	Estimated number of participants needed to achieve study objectives and how it was determined, including clinical and statistical assumptions supporting any sample size calculations	P 8
Recruitment	15	Strategies for achieving adequate participant enrolment to reach target sample size	P7-8
Methods: Assignment of interventions (for controlled trials)			
Allocation:			
Sequence generation	16a	Method of generating the allocation sequence (eg, computer-generated random numbers), and list of any factors for stratification. To reduce predictability of a random sequence, details of any planned restriction (eg, blocking) should be provided in a separate document that is unavailable to those who enrol participants or assign interventions	P 8

Allocation concealment mechanism	16b	Mechanism of implementing the allocation sequence (eg, central telephone; sequentially numbered, opaque, sealed envelopes), describing any steps to conceal the sequence until interventions are assigned	P 7
Implementation	16c	Who will generate the allocation sequence, who will enrol participants, and who will assign participants to interventions	P 8
Blinding (masking)	17a	Who will be blinded after assignment to interventions (eg, trial participants, care providers, outcome assessors, data analysts), and how	P 8
	17b	If blinded, circumstances under which unblinding is permissible, and procedure for revealing a participant's allocated intervention during the trial	NA
Methods: Data collection, management, and analysis			
Data collection methods	18a	Plans for assessment and collection of outcome, baseline, and other trial data, including any related processes to promote data quality (eg, duplicate measurements, training of assessors) and a description of study instruments (eg, questionnaires, laboratory tests) along with their reliability and validity, if known. Reference to where data collection forms can be found, if not in the protocol	P11-12
	18b	Plans to promote participant retention and complete follow-up, including list of any outcome data to be collected for participants who discontinue or deviate from intervention protocols	P 9
Data management	19	Plans for data entry, coding, security, and storage, including any related processes to promote data quality (eg, double data entry; range checks for data values). Reference to where details of data management procedures can be found, if not in the protocol	P 8
Statistical methods	20a	Statistical methods for analysing primary and secondary outcomes. Reference to where other details of the statistical analysis plan can be found, if not in the protocol	P 13
	20b	Methods for any additional analyses (eg, subgroup and adjusted analyses)	NA
	20c	Definition of analysis population relating to protocol non-adherence (eg, as randomised analysis), and any statistical methods to handle missing data (eg, multiple imputation)	P13-14
Methods: Monitoring			
Data monitoring	21a	Composition of data monitoring committee (DMC); summary of its role and reporting structure; statement of whether it is independent from the sponsor and competing interests; and reference to where further details about its charter can be found, if not in the protocol. Alternatively, an explanation of why a DMC is not needed	NA

	21b	Description of any interim analyses and stopping guidelines, including who will have access to these interim results and make the final decision to terminate the trial	NA
Harms	22	Plans for collecting, assessing, reporting, and managing solicited and spontaneously reported adverse events and other unintended effects of trial interventions or trial conduct	NA
Auditing	23	Frequency and procedures for auditing trial conduct, if any, and whether the process will be independent from investigators and the sponsor	NA
Ethics and dissemination			
Research ethics approval	24	Plans for seeking research ethics committee/institutional review board (REC/IRB) approval	P 3
Protocol amendments	25	Plans for communicating important protocol modifications (eg, changes to eligibility criteria, outcomes, analyses) to relevant parties (eg, investigators, REC/IRBs, trial participants, trial registries, journals, regulators)	
Consent or assent	26a	Who will obtain informed consent or assent from potential trial participants or authorised surrogates, and how (see Item 32)	P 7
	26b	Additional consent provisions for collection and use of participant data and biological specimens in ancillary studies, if applicable	NA
Confidentiality	27	How personal information about potential and enrolled participants will be collected, shared, and maintained in order to protect confidentiality before, during, and after the trial	P 8
Declaration of interests	28	Financial and other competing interests for principal investigators for the overall trial and each study site	P 18
Access to data	29	Statement of who will have access to the final trial dataset, and disclosure of contractual agreements that limit such access for investigators	
Ancillary and post-trial care	30	Provisions, if any, for ancillary and post-trial care, and for compensation to those who suffer harm from trial participation	NA
Dissemination policy	31a	Plans for investigators and sponsor to communicate trial results to participants, healthcare professionals, the public, and other relevant groups (eg, via publication, reporting in results databases, or other data sharing arrangements), including any publication restrictions	P 3
	31b	Authorship eligibility guidelines and any intended use of professional writers	NA
	31c	Plans, if any, for granting public access to the full protocol, participant-level dataset, and statistical code	NA

Appendices

Informed consent materials	32	Model consent form and other related documentation given to participants and authorised surrogates	NA online
Biological specimens	33	Plans for collection, laboratory evaluation, and storage of biological specimens for genetic or molecular analysis in the current trial and for future use in ancillary studies, if applicable	NA

*It is strongly recommended that this checklist be read in conjunction with the SPIRIT 2013 Explanation & Elaboration for important clarification on the items. Amendments to the protocol should be tracked and dated. The SPIRIT checklist is copyrighted by the SPIRIT Group under the Creative Commons "Attribution-NonCommercial-NoDerivs 3.0 Unported" license.